Remarks

Applicants' representative would like to thank the Examiner for discussing the final Office Action of November 26, 2004 with him. Applicants are submitting a supplemental information disclosure statement with this response. Applicants respectfully request the Examiner to consider the references provided in addition to the remarks below.

35 U.S.C. 112, first Paragraph

Claims 1-4 have been rejected as allegedly unpatentable under 35 U.S.C. § 112, first paragraph, as being non-enabled for the prevention of breast cancer. The Examiner, in the Office Action dated June 4, 2003, asserted that the utility of breast cancer prevention "is not believable on it face" and further stated that "there is no known art where a certain compound is administered to successfully prevent breast cancer." This rejection was maintained in the final Office Action of November 26, 2004.

Applicants respectfully traverse this rejection. Applicants maintain that the prevention of breast cancer is a credible utility that is clear, definite and understood by one skilled in the art. Applicants submit that one skilled in the art understands that the reduction in incidence of breast cancer is prevention of breast cancer.

To illustrate the knowledge of those skilled in the art with respect to the prevention of breast cancer, applicants are submitting herewith the FDA approved label for tamoxifen citrate and three documents printed from the web site of the National Cancer Institute.

The compound tamoxifen citrate (sold as Nolvadex® by AstraZeneca) is presently approved by the FDA and is indicated for "Reduction in Breast Cancer Incidence in High Risk Women." The reduction in incidence of breast cancer indication was approved on the basis of "The Breast Cancer Prevention Trial", "The Italian Tamoxifen Prevention trial" and the "Royal Marsden Trial" which are described at pages 8 through 14 of the Nolvadex® label submitted herewith. These trials were conducted in order to determine whether administration of tamoxifen would prevent breast cancer in women at high risk of developing the disease. After a median period of 4.2 years, tamoxifen was shown to reduce the incidence of breast cancer (i.e. prevent breast cancer) by 44% when compared to placebo in "The Breast Cancer Prevention Trial" (see the Nolvadex® label at page 10, lines 10-16).

To further illustrate the knowledge of those skilled in the art, enclosed herewith are three documents printed from the web site of the National Cancer Institute. The first document titled "Cancer Facts" and subtitled "Breast Cancer Prevention Studies" highlights the breast cancer prevention studies that are presently being conducted and discusses the prevention of breast cancer. The second document titled "Prevention of Breast Cancer" describes clinical studies that were or are being conducted for the prevention of breast cancer. Applicants particularly point out pages 10-13 of "Prevention of Breast Cancer" where studies on the prevention of breast cancer using the SERM compounds tamoxifen or raloxifene hydrocloride, which is marketed as Evista® by Eli Lilly and Company, are described. The third document titled "Cancer Facts" and subtitled "Chemoprevention" at the top of page 2 states that women taking tamoxifen had 49 percent fewer diagnosed cases of breast cancer and therefore indicated that a chemopreventive agent could be effective in preventing cancer. Thus, the prevention of breast cancer is well known to those skilled in the art as the reduction in incidence of breast cancer and is not an incredible utility.

In addition, both tamoxifien citrate and raloxifene hydrocloride are estrogen receptor modulators. The compounds of the present claims are also estrogen receptor modulators having different chemical structures from tamoxifen citrate and raloxifene hydrochloride. Thus, that an estrogen receptor modulator could be used for the prevention of breast cancer is a credible assertion for an estrogen receptor modulator.

Because the prevention of breast cancer is well known to those skilled in the art, applicants believe that the utility of the presently claimed invention is credible. Applicants respectfully request the Examiner to consider both the references provided in the supplemental information disclosure statement and the remarks hereinabove and to withdraw the present rejection.

Applicants believe that, in view of the remarks made above, this application is in condition for allowance. Reconsideration and allowance of claims 1-4 is respectfully requested.

Date: 24 MARCH 2005

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NOLVADEX

(Tamoxifen Citrate)

TABLETS

WARNING - For Women with Ductal Carcinoma in Situ (DCIS) and Women at High Risk for Breast Cancer: Serious and life-threatening events associated with NOLVADEX in the risk reduction setting (women at high risk for cancer and women with DCIS) include uterine malignancies, stroke and pulmonary embolism. Incidence rates for these events were estimated from the NSABP P-1 trial (see **CLINICAL PHARMACOLOGY-Clinical Studies – Reduction in Breast Cancer Incidence In High Risk Women**). Uterine malignancies consist of both endometrial adenocarcinoma (incidence rate per 1,000 women-years of 2.20 for NOLVADEX vs 0.71 for placebo) and uterine sarcoma (incidence rate per 1,000 women-years of 0.17 for NOLVADEX vs 0.0 for placebo)*. For stroke, the incidence rate per 1,000 women-years was 1.43 for NOLVADEX vs 1.00 for placebo**. For pulmonary embolism, the incidence rate per 1,000 women-years was 0.75 for NOLVADEX versus 0.25 for placebo**.

Some of the strokes, pulmonary emboli, and uterine malignancies were fatal.

Health care providers should discuss the potential benefits versus the potential risks of these serious events with women at high risk of breast cancer and women with DCIS considering NOLVADEX to reduce their risk of developing breast cancer.

The benefits of NOLVADEX outweigh its risks in women already diagnosed with breast cancer.

*Updated long-term follow-up data (median length of follow-up is 6.9 years) from NSABP P-1 study. See **WARNINGS: Effects on the Uterus-Endometrial Cancer and Uterine Sarcoma.**
See Table 3 under **CLINICAL PHARMACOLOGY-Clinical Studies.

DESCRIPTION

NOLVADEX® (tamoxifen citrate) Tablets, a nonsteroidal antiestrogen, are for oral administration. NOLVADEX Tablets are available as:

10 mg Tablets:

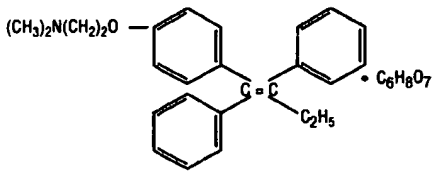
Each tablet contains 15.2 mg of tamoxifen citrate which is equivalent to 10 mg of tamoxifen.

20 mg Tablets:

Each tablet contains 30.4 mg of tamoxifen citrate which is equivalent to 20 mg of tamoxifen.

Inactive Ingredients: carboxymethylcellulose calcium, magnesium stearate, mannitol and starch.

Chemically, NOLVADEX is the trans-isomer of a triphenylethylene derivative. The chemical name is (Z)2-[4-(1,2-diphenyl-1-butenyl) phenoxy]-N, N-dimethylethanamine 2 hydroxy-1,2,3-propanetricarboxylate (1:1). The structural and empirical formulas are:



$(C_{32}H_{37}NO_8)$

Tamoxifen citrate has a molecular weight of 563.62, the pKa' is 8.85, the equilibrium solubility in water at 37°C is 0.5 mg/mL and in 0.02 N HCl at 37°C, it is 0.2 mg/mL.

CLINICAL PHARMACOLOGY

NOLVADEX is a nonsteroidal agent that has demonstrated potent antiestrogenic properties in animal test systems. The antiestrogenic effects may be related to its ability to compete with estrogen for binding sites in target tissues such as breast. Tamoxifen inhibits the induction of rat mammary carcinoma induced by dimethylbenzanthracene (DMBA) and causes the regression of already established DMBA-induced tumors. In this rat model, tamoxifen appears to exert its antitumor effects by binding the estrogen receptors.

In cytosols derived from human breast adenocarcinomas, tamoxifen competes with estradiol for estrogen receptor protein.

Absorption and Distribution:

Following a single oral dose of 20 mg tamoxifen, an average peak plasma concentration of 40 ng/mL (range 35 to 45 ng/mL) occurred approximately 5 hours after dosing. The decline in plasma concentrations of tamoxifen is biphasic with a terminal elimination half-life of about 5 to 7 days. The average peak plasma concentration of N-desmethyl tamoxifen is 15 ng/mL (range 10 to 20 ng/mL). Chronic administration of 10 mg tamoxifen given twice daily for 3 months to patients results in average steady-state plasma concentrations of 120 ng/mL (range 67-183 ng/mL) for tamoxifen and 336 ng/mL (range 148-654 ng/mL) for N-desmethyl tamoxifen. The average steady-state plasma concentrations of tamoxifen and N-desmethyl tamoxifen after administration of 20 mg tamoxifen once daily for 3 months are 122 ng/mL (range 71-183 ng/mL) and 353 ng/mL (range 152-706 ng/mL), respectively. After initiation of therapy, steady state concentrations for tamoxifen are achieved in about 4 weeks and steady-state concentrations for N-desmethyl tamoxifen are achieved in about 8 weeks, suggesting a half-life of approximately 14 days for this metabolite. In a steady-state, crossover study of 10 mg NOLVADEX tablets given twice a day vs. a 20 mg NOLVADEX tablet given once daily, the 20 mg NOLVADEX tablet was bioequivalent to the 10 mg NOLVADEX tablets.

Metabolism:

Tamoxifen is extensively metabolized after oral administration. N-desmethyl tamoxifen is the major metabolite found in patients' plasma. The biological activity of N-desmethyl tamoxifen appears to be similar to that of tamoxifen. 4-Hydroxytamoxifen and a side chain primary alcohol derivative of tamoxifen have been identified as minor metabolites in plasma. Tamoxifen is a substrate of cytochrome P-450 3A, 2C9 and 2D6, and an inhibitor of P-glycoprotein.

Excretion:

Studies in women receiving 20 mg of ^{14}C tamoxifen have shown that approximately 65% of the administered dose was excreted from the body over a period of 2 weeks with fecal excretion as the primary route of elimination. The drug is excreted mainly as polar conjugates, with unchanged drug and unconjugated metabolites accounting for less than 30% of the total fecal radioactivity.

Special Populations:

The effects of age, gender and race on the pharmacokinetics of tamoxifen have not been determined. The effects of reduced liver function on the metabolism and pharmacokinetics of tamoxifen have not been determined.

Pediatric Patients:

The pharmacokinetics of tamoxifen and N-desmethyl tamoxifen were characterized using a population pharmacokinetic analysis with sparse samples per patient obtained from 27 female pediatric patients aged 2 to 10 years enrolled in a study designed to evaluate the safety, efficacy, and pharmacokinetics of NOLVADEX in treating McCune-Albright Syndrome. Rich data from two tamoxifen citrate pharmacokinetic trials in which 59 postmenopausal women with breast cancer completed the studies were included in the analysis to determine the structural pharmacokinetic model for tamoxifen. A one-compartment model provided the best fit to the data.

In pediatric patients, an average steady state peak plasma concentration ($C_{ss,\ max}$) and AUC were of 187 ng/mL and 4110 ng hr/mL, respectively, and $C_{ss,\ max}$ occurred approximately 8 hours after dosing. Clearance (CL/F) as body weight adjusted in female pediatric patients was approximately 2.3-fold higher than in female breast cancer patients. In the youngest cohort of female pediatric patients (2-6 year olds), CL/F was 2.6-fold higher; in the oldest cohort (7-10.9 year olds) CL/F was approximately 1.9-fold higher. Exposure to N-desmethyl tamoxifen was comparable between the pediatric and adult patients. **The safety and efficacy of NOLVADEX for girls aged two to 10 years with McCune-Albright Syndrome and precocious puberty have not been studied beyond one year of treatment. The long-term effects of NOLVADEX therapy in girls have not been established.** In adults treated with NOLVADEX an increase in incidence of uterine malignancies, stroke and pulmonary embolism has been noted (see **BOXED WARNING**).

Drug-Drug Interactions:

In vitro studies showed that erythromycin, cyclosporin, nifedipine and diltiazem competitively inhibited formation of N-desmethyl tamoxifen with apparent K_I of 20, 1, 45 and 30 μM, respectively. The clinical significance of these *in vitro* studies is unknown.

Tamoxifen reduced the plasma concentration of letrozole by 37% when these drugs were co-administered. Rifampin, a cytochrome P-450 3A4 inducer reduced tamoxifen AUC and C_{max} by 86% and 55%, respectively. Aminoglutethimide reduces tamoxifen and N-desmethyl tamoxifen plasma concentrations. Medroxyprogesterone reduces plasma concentrations of N-desmethyl, but not tamoxifen.

Clinical Studies

Metastatic Breast Cancer:

Premenopausal Women (NOLVADEX vs. Ablation):

Three prospective, randomized studies (Ingle, Pritchard, Buchanan) compared NOLVADEX to ovarian ablation (oophorectomy or ovarian irradiation) in premenopausal women with advanced breast cancer. Although the objective response rate, time to treatment failure, and survival were similar with both treatments, the limited patient accrual prevented a demonstration of equivalence. In an overview analysis of survival data from the 3 studies, the hazard ratio for death (NOLVADEX/ovarian ablation) was 1.00 with two-sided 95% confidence intervals of 0.73 to 1.37. Elevated serum and plasma estrogens have been observed in premenopausal women receiving NOLVADEX, but the data from the randomized studies do not suggest an adverse effect of this increase. A limited number of premenopausal patients with disease progression during NOLVADEX therapy responded to subsequent ovarian ablation.

Male Breast Cancer:

Published results from 122 patients (119 evaluable) and case reports in 16 patients (13 evaluable) treated with NOLVADEX have shown that NOLVADEX is effective for the palliative treatment of male breast cancer. Sixty-six of these 132 evaluable patients responded to NOLVADEX which constitutes a 50% objective response rate.

Adjuvant Breast Cancer:

Overview:

The Early Breast Cancer Trialists' Collaborative Group (EBCTCG) conducted worldwide overviews of systemic adjuvant therapy for early breast cancer in 1985, 1990, and again in 1995. In 1998, 10-year outcome data were reported for 36,689 women in 55 randomized trials of adjuvant NOLVADEX using doses of 20-40 mg/day for 1-5+ years. Twenty-five percent of patients received 1 year or less of trial treatment, 52% received 2 years, and 23% received about 5 years. Forty-eight percent of tumors were estrogen receptor (ER) positive (> 10 fmol/mg), 21% were ER poor (< 10 fmol/l), and 31% were ER unknown. Among 29,441 patients with ER positive or unknown breast cancer, 58% were entered into trials comparing NOLVADEX to no adjuvant therapy and 42% were entered into trials comparing NOLVADEX in combination with chemotherapy vs. the same chemotherapy alone. Among these patients, 54% had node positive disease and 46% had node negative disease.

Among women with ER positive or unknown breast cancer and positive nodes who received about 5 years of treatment, overall survival at 10 years was 61.4% for NOLVADEX vs. 50.5% for control (logrank $2p < 0.00001$). The recurrence-free rate at 10 years was 59.7% for NOLVADEX vs. 44.5% for control (logrank $2p < 0.00001$). Among women with ER positive or unknown breast cancer and negative nodes who received about 5 years of treatment, overall survival at 10 years was 78.9% for NOLVADEX vs. 73.3% for control (logrank $2p < 0.00001$). The recurrence-free rate at 10 years was 79.2% for NOLVADEX versus 64.3% for control (logrank $2p < 0.00001$).

The effect of the scheduled duration of tamoxifen may be described as follows. In women with ER positive or unknown breast cancer receiving 1 year or less, 2 years or about 5 years of NOLVADEX, the proportional reductions in mortality were 12%, 17% and 26%, respectively (trend significant at $2p < 0.003$). The corresponding reductions in breast cancer recurrence were 21%, 29% and 47% (trend significant at $2p < 0.00001$).

Benefit is less clear for women with ER poor breast cancer in whom the proportional reduction in recurrence was 10% ($2p = 0.007$) for all durations taken together, or 9% ($2p = 0.02$) if contralateral breast cancers are excluded. The corresponding reduction in mortality was 6% (NS). The effects of about 5 years of NOLVADEX on recurrence and mortality were similar regardless of age and concurrent chemotherapy. There was no indication that doses greater than 20 mg per day were more effective.

Node Positive - Individual Studies:

Two studies (Hubay and NSABP B-09) demonstrated an improved disease-free survival following radical or modified radical mastectomy in postmenopausal women or women 50 years of age or older with surgically curable breast cancer with positive axillary nodes when NOLVADEX was added to adjuvant cytotoxic chemotherapy. In the Hubay study, NOLVADEX was added to "low-dose" CMF (cyclophosphamide, methotrexate and fluorouracil). In the NSABP B-09 study, NOLVADEX was added to melphalan [L-phenylalanine mustard (P)] and fluorouracil (F).

In the Hubay study, patients with a positive (more than 3 fmol) estrogen receptor were more likely to benefit. In the NSABP B-09 study in women age 50-59 years, only women with both estrogen and progesterone receptor levels 10 fmol or greater clearly benefited, while there was a nonstatistically significant trend toward adverse effect in women with both estrogen and progesterone receptor levels less than 10 fmol. In women age 60-70 years, there was a trend toward a beneficial effect of NOLVADEX without any clear relationship to estrogen or progesterone receptor status.

Three prospective studies (ECOG-1178, Toronto, NATO) using NOLVADEX adjuvantly as a single agent demonstrated an improved disease-free survival following total mastectomy and axillary dissection for postmenopausal women with positive axillary nodes compared to placebo/no treatment controls. The NATO study also demonstrated an overall survival benefit.

Node Negative - Individual Studies:

NSABP B-14, a prospective, double-blind, randomized study, compared NOLVADEX to placebo in women with axillary node-negative, estrogen-receptor positive (≥10 fmol/mg cytosol protein) breast cancer (as adjuvant therapy, following total mastectomy and axillary dissection, or segmental resection, axillary dissection, and breast radiation). After five years of treatment, there was a significant improvement in disease-free survival in women receiving NOLVADEX. This benefit was apparent both in women under age 50 and in women at or beyond age 50.

One additional randomized study (NATO) demonstrated improved disease-free survival for NOLVADEX compared to no adjuvant therapy following total mastectomy and axillary dissection in postmenopausal women with axillary node-negative breast cancer. In this study, the benefits of NOLVADEX appeared to be independent of estrogen receptor status.

Duration of Therapy:

In the EBCTCG 1995 overview, the reduction in recurrence and mortality was greater in those studies that used tamoxifen for about 5 years than in those that used tamoxifen for a shorter period of therapy.

In the NSABP B-14 trial, in which patients were randomized to NOLVADEX 20 mg/day for 5 years vs. placebo and were disease-free at the end of this 5-year period were offered rerandomization to an additional 5 years of NOLVADEX or placebo. With 4 years of follow-up after this rerandomization, 92% of the women that received 5 years of NOLVADEX were alive and disease-free, compared to 86% of the women scheduled to receive 10 years of NOLVADEX (p=0.003). Overall survivals were 96% and 94%, respectively (p=0.08). Results of the B-14 study suggest that continuation of therapy beyond 5 years does not provide additional benefit.

A Scottish trial of 5 years of tamoxifen vs. indefinite treatment found a disease-free survival of 70% in the five-year group and 61% in the indefinite group, with 6.2 years median follow-up (HR=1.27, 95% CI 0.87-1.85).

In a large randomized trial conducted by the Swedish Breast Cancer Cooperative Group of adjuvant NOLVADEX 40 mg/day for 2 or 5 years, overall survival at 10 years was estimated to be 80% in the patients in the 5-year tamoxifen group, compared with 74% among corresponding patients in the 2-year treatment group (p=0.03). Disease-free survival at 10 years was 73% in the 5-year group and 67% in the 2-year group (p=0.009). Compared with 2 years of tamoxifen treatment, 5 years of treatment resulted in a slightly greater reduction in the incidence of contralateral breast cancer at 10 years, but this difference was not statistically significant.

Contralateral Breast Cancer:

The incidence of contralateral breast cancer is reduced in breast cancer patients (premenopausal and postmenopausal) receiving NOLVADEX compared to placebo. Data on contralateral breast cancer are available from 32,422 out of 36,689 patients in the 1995 overview analysis of the Early Breast Cancer Trialists Collaborative Group (EBCTCG). In clinical trials with NOLVADEX of 1 year or less, 2 years, and about 5 years duration, the proportional reductions in the incidence rate of contralateral breast cancer among women receiving NOLVADEX were 13% (NS), 26% ($2p = 0.004$) and 47% ($2p < 0.00001$), with a significant trend favoring longer tamoxifen duration ($2p = 0.008$). The proportional reductions in the incidence of contralateral breast cancer were independent of age and ER status of the primary tumor. Treatment with about 5 years of NOLVADEX reduced the annual incidence rate of contralateral breast cancer from 7.6 per 1,000 patients in the control group compared with 3.9 per 1,000 patients in the tamoxifen group.

In a large randomized trial in Sweden (the Stockholm Trial) of adjuvant NOLVADEX 40 mg/day for 2-5 years, the incidence of second primary breast tumors was reduced 40% ($p < 0.008$) on tamoxifen compared to control. In the NSABP B-14 trial in which patients were randomized to NOLVADEX 20 mg/day for 5 years vs. placebo, the incidence of second primary breast cancers was also significantly reduced ($p < 0.01$). In NSABP B-14, the annual rate of contralateral breast cancer was 8.0 per 1000 patients in the placebo group compared with 5.0 per 1,000 patients in the tamoxifen group, at 10 years after first randomization.

Ductal Carcinoma in Situ:

NSABP B-24, a double-blind, randomized trial included women with ductal carcinoma in situ (DCIS). This trial compared the addition of NOLVADEX or placebo to treatment with lumpectomy and radiation therapy for women with DCIS. The primary objective was to determine whether 5 years of NOLVADEX therapy (20 mg/day) would reduce the incidence of invasive breast cancer in the ipsilateral (the same) or contralateral (the opposite) breast.

In this trial 1,804 women were randomized to receive either NOLVADEX or placebo for 5 years: 902 women were randomized to NOLVADEX 10 mg tablets twice a day and 902 women were randomized to placebo. As of December 31, 1998, follow-up data were available for 1,798 women and the median duration of follow-up was 74 months.

The NOLVADEX and placebo groups were well balanced for baseline demographic and prognostic factors. Over 80% of the tumors were less than or equal to 1 cm in their maximum dimension, were not palpable, and were detected by mammography alone. Over 60% of the study population was postmenopausal. In 16% of patients, the margin of the resected specimen was reported as being positive after surgery. Approximately half of the tumors were reported to contain comedo necrosis.

For the primary endpoint, the incidence of invasive breast cancer was reduced by 43% among women assigned to NOLVADEX (44 cases - NOLVADEX, 74 cases - placebo; p=0.004; relative risk (RR)=0.57, 95% CI: 0.39-0.84). No data are available regarding the ER status of the invasive cancers. The stage distribution of the invasive cancers at diagnosis was similar to that reported annually in the SEER data base.

Results are shown in Table 1. For each endpoint the following results are presented: the number of events and rate per 1,000 women per year for the placebo and NOLVADEX groups; and the relative risk (RR) and its associated 95% confidence interval (CI) between NOLVADEX and placebo. Relative risks less than 1.0 indicate a benefit of NOLVADEX therapy. The limits of the confidence intervals can be used to assess the statistical significance of the benefits of NOLVADEX therapy. If the upper limit of the CI is less than 1.0, then a statistically significant benefit exists.

Table 1. Major Outcomes of the NSABP B-24 Trial

Type of Event	Lumpectomy, radiotherapy, and placebo		Lumpectomy, radiotherapy, and NOLVADEX		RR	95% CI Limits
	No. of events	Rate per 1000 women per year	No. of events	Rate per 1000 women per year		

Invasive breast cancer (Primary endpoint)	**74**	**16.73**	**44**	**9.60**	**0.57**	**0.39 to 0.84**
-Ipsilateral	47	10.61	27	5.90	0.56	0.33 to 0.91
-Contralateral	25	5.64	17	3.71	0.66	0.33 to 1.27
-Side undertermined	2	--	0	--	--	
Secondary Endpoints						
DCIS	56	12.66	41	8.95	0.71	0.46 to 1.08
-Ipsilateral	46	10.40	38	8.29	0.88	0.51 to 1.25
-Contralateral	10	2.26	3	0.65	0.29	0.05 to 1.13
All Breast Cancer Events	129	29.16	84	18.34	0.63	0.47 to 0.83
-All ipsilateral events	96	21.70	65	14.19	0.65	0.47 to 0.91
-All contralateral events	37	8.36	20	4.37	0.52	0.29 to 0.92
Deaths	32		28			
Uterine Malignancies[1]	4		9			
Endometrial Adenocarcinoma[1]	4	0.57	8	1.15		
Uterine Sarcoma[1]	0	0.0	1	0.14		
Second primary malignancies (other than endometrial and breast)	30		29			
Stroke	2		7			
Thromboembolic events (DVT, PE)	5		15			

[1]Updated follow-up data (median 8.1 years)

Survival was similar in the placebo and NOLVADEX groups. At 5 years from study entry, survival was 97% for both groups.

Reduction in Breast Cancer Incidence in High Risk Women:

The Breast Cancer Prevention Trial (BCPT, NSABP P-1) was a double-blind, randomized, placebo-controlled trial with a primary objective to determine whether 5 years of NOLVADEX therapy (20 mg/day) would reduce the incidence of invasive breast cancer in women at high risk for the disease (See **INDICATIONS AND USAGE**). Secondary objectives included an evaluation of the incidence of ischemic heart disease; the effects on the incidence of bone fractures; and other events that might be associated with the use of NOLVADEX, including: endometrial cancer, pulmonary embolus, deep vein thrombosis, stroke, and cataract formation and surgery (See **WARNINGS**).

The Gail Model was used to calculate predicted breast cancer risk for women who were less than 60 years of age and did not have lobular carcinoma in situ (LCIS). The following risk factors were used: age; number of first-degree female relatives with breast cancer; previous breast

biopsies; presence or absence of atypical hyperplasia; nulliparity; age at first live birth; and age at menarche. A 5-year predicted risk of breast cancer of ≥ 1.67% was required for entry into the trial.

In this trial, 13,388 women of at least 35 years of age were randomized to receive either NOLVADEX or placebo for five years. The median duration of treatment was 3.5 years. As of January 31, 1998, follow-up data is available for 13,114 women. Twenty-seven percent of women randomized to placebo (1,782) and 24% of women randomized to NOLVADEX (1,596) completed 5 years of therapy. The demographic characteristics of women on the trial with follow-up data are shown in Table 2.

Table 2. Demographic Characteristics of Women in the NSABP P-1 Trial

Characteristic	Placebo		Tamoxifen	
	#	%	#	%
Age (yrs.)				
35-39	184	3	158	2
40-49	2,394	36	2,411	37
50-59	2,011	31	2,019	31
60-69	1,588	24	1,563	24
≥70	393	6	393	6
Age at first live birth (yrs.)				
Nulliparous	1,202	18	1,205	18
12-19	915	14	946	15
20-24	2,448	37	2,449	37
25-29	1,399	21	1,367	21
≥30	606	9	577	9
Race				
White	6,333	96	6,323	96
Black	109	2	103	2
Other	128	2	118	2
Age at menarche				
≥14	1,243	19	1,170	18
12-13	3,610	55	3,610	55
≤11	1,717	26	1,764	27
# of first degree relatives with breast cancer				
0	1,584	24	1,525	23
1	3,714	57	3,744	57
2+	1,272	19	1,275	20
Prior Hysterectomy				
No	4,173	63.5	4,018	62.4
Yes	2,397	36.5	2,464	37.7
# of previous breast biopsies				
0	2,935	45	2,923	45
1	1,833	28	1,850	28
≥2	1,802	27	1,771	27
History of atypical hyperplasia in the breast				
No	5,958	91	5,969	91
Yes	612	9	575	9
History of LCIS at entry				
No	6,165	94	6,135	94

Yes	405	6	409	6
5-year predicted breast cancer risk (%)				
≤2.00	1,646	25	1,626	25
2.01-3.00	2,028	31	2,057	31
3.01-5.00	1,787	27	1,707	26
≥5.01	1,109	17	1,162	18
Total	6,570	100.0	6,544	100.0

Results are shown in Table 3. After a median follow-up of 4.2 years, the incidence of invasive breast cancer was reduced by 44% among women assigned to NOLVADEX (86 cases-NOLVADEX, 156 cases-placebo; $p<0.00001$; relative risk (RR)=0.56, 95% CI: 0.43-0.72). A reduction in the incidence of breast cancer was seen in each prospectively specified age group (≤ 49, 50-59, ≥ 60), in women with or without LCIS, and in each of the absolute risk levels specified in Table 3. A non-significant decrease in the incidence of ductal carcinoma in situ (DCIS) was seen (23-NOLVADEX, 35-placebo; RR=0.66; 95% CI: 0.39-1.11).

There was no statistically significant difference in the number of myocardial infarctions, severe angina, or acute ischemic cardiac events between the two groups (61-NOLVADEX, 59-placebo; RR=1.04, 95% CI: 0.73-1.49).

No overall difference in mortality (53 deaths in NOLVADEX group vs. 65 deaths in placebo group) was present. No difference in breast cancer-related mortality was observed (4 deaths in NOLVADEX group vs. 5 deaths in placebo group).

Although there was a non-significant reduction in the number of hip fractures (9 on NOLVADEX, 20 on placebo) in the NOLVADEX group, the number of wrist fractures was similar in the two treatment groups (69 on NOLVADEX, 74 on placebo). A subgroup analysis of the P-1 trial, suggests a difference in effect in bone mineral density (BMD) related to menopausal status in patients receiving NOLVADEX. In postmenopausal women there was no evidence of bone loss of the lumbar spine and hip. Conversely, NOLVADEX was associated with significant bone loss of the lumbar spine and hip in premenopausal women.

The risks of NOLVADEX therapy include endometrial cancer, DVT, PE, stroke, cataract formation and cataract surgery (See Table 3). In the NSABP P-1 trial, 33 cases of endometrial cancer were observed in the NOLVADEX group vs. 14 in the placebo group (RR=2.48, 95% CI: 1.27-4.92). Deep vein thrombosis was observed in 30 women receiving NOLVADEX vs. 19 in women receiving placebo (RR=1.59, 95% CI: 0.86-2.98). Eighteen cases of pulmonary embolism were observed in the NOLVADEX group vs. 6 in the placebo group (RR=3.01, 95% CI: 1.15-9.27). There were 34 strokes on the NOLVADEX arm and 24 on the placebo arm (RR=1.42; 95% CI: 0.82-2.51). Cataract formation in women without cataracts at baseline was observed in 540 women taking NOLVADEX vs. 483 women receiving placebo (RR=1.13, 95% CI: 1.00-1.28). Cataract surgery (with or without cataracts at baseline) was performed in 201 women taking NOLVADEX vs. 129 women receiving placebo (RR=1.51, 95% CI: 1.21-1.89) (See **WARNINGS**).

Table 3 summarizes the major outcomes of the NSABP P-1 trial. For each endpoint, the following results are presented: the number of events and rate per 1000 women per year for the placebo and NOLVADEX groups; and the relative risk (RR) and its associated 95% confidence interval (CI) between NOLVADEX and placebo. Relative risks less than 1.0 indicate a benefit of NOLVADEX therapy. The limits of the confidence intervals can be used to assess the statistical significance of the benefits or risks of NOLVADEX therapy. If the upper limit of the CI is less than 1.0, then a statistically significant benefit exists.

For most participants, multiple risk factors would have been required for eligibility. This table considers risk factors individually, regardless of other co-existing risk factors, for women who developed breast cancer. The 5-year predicted absolute breast cancer risk accounts for multiple risk factors in an individual and should provide the best estimate of individual benefit (See **INDICATIONS AND USAGE**).

Table 3. Major Outcomes of the NSABP P-1 Trial

	# OF EVENTS		RATE/1000 WOMEN/YEAR			95% CI
TYPE OF EVENT	PLACEBO	NOLVADEX	PLACEBO	NOLVADEX	RR	LIMITS
Invasive Breast Cancer	156	86	6.49	3.58	0.56	0.43-0.72
Age ≤49	59	38	6.34	4.11	0.65	0.43-0.98
Age 50-59	46	25	6.31	3.53	0.56	0.35-0.91
Age ≥60	51	23	7.17	3.22	0.45	0.27-0.74
Risk Factors for Breast Cancer						
History, LCIS						
No	140	78	6.23	3.51	0.56	0.43-0.74
Yes	16	8	12.73	6.33	0.50	0.21-1.17
History, Atypical Hyperplasia						
No	1.38	84	6.37	3.89	0.61	0.47-0.80
Yes	18	2	8.69	1.05	0.12	0.03-0.52
No. First Degree Relatives						
0	32	17	5.97	3.26	0.55	0.30-0.98
1	80	45	5.81	3.31	0.57	0.40-0.82
2	35	18	8.92	4.67	0.52	0.30-0.92
≥3	9	6	13.33	7.58	0.57	0.20-1.59
5-Year Predicted Breast Cancer Risk (as calculated by the Gail Model)						
≤2.00%	31	13	5.36	2.26	0.42	0.22-0.81
2.01-3.00%	39	28	5.25	3.83	0.73	0.45-1.18
3.01-5.00%	36	26	5.37	4.06	0.76	0.46-1.26
≥5.00%	50	19	13.15	4.71	0.36	0.21-0.61
DCIS	35	23	1.47	0.97	0.66	0.39-1.11
Fractures (protocol-specified sites)	92[1]	76[1]	3.87	3.20	0.61	0.83-1.12
Hip	20	9	0.84	0.38	0.45	0.18-1.04
Wrist[2]	74	69	3.11	2.91	0.93	0.67-1.29
Total Ischemic Events	59	61	2.47	2.57	1.04	0.71-1.51
Myocardial Infarction	27	27	1.13	1.13	1.00	0.57-1.78
Fatal	8	7	0.33	0.29	0.88	0.27-2.77
Nonfatal	19	20	0.79	0.84	1.06	0.54-2.09
Angina[3]	12	12	0.50	0.50	1.00	0.41-2.44
Acute Ischemic Syndrome[4]	20	22	0.84	0.92	1.11	0.58-2.13

Uterine Malignancies (among women with an intact uterus)[10]	17	57				
Endometrial Adenocarcinoma[10]	17	53	0.71	2.20		
Uterine Sarcoma[10]	0	4	0.0	0.17		
Stroke[5]	24	34	1.00	1.43	1.42	0.82-2.51
Transient Ischemic Attack	21	18	0.88	0.75	0.86	0.43-1.70
Pulmonary Emboli[6]	6	18	0.25	0.75	3.01	1.15-9.27
Deep-Vein Thrombosis[7]	19	30	0.79	1.26	1.59	0.86-2.98
Cataracts Developing on Study[8]	483	540	22.51	25.41	1.13	1.00-1.28
Underwent Cataract Surgery[8]	63	101	2.83	4.57	1.62	1.18-2.22
Underwent Cataract Surgery[9]	1.29	201	5.44	8.56	1.58	1.26-1.97

[1]Two women had hip and wrist fractures
[2] Includes Colles' and other lower radius fractures
[3]Requiring angioplasty or CABG
[4]New Q-wave on ECG; no angina or elevation of serum enzymes; or angina requiring hospitalization without surgery
[5]Seven cases were fatal; three in the placebo group and four in the NOLVADEX group
[6]Three cases in the NOLVADEX group were fatal
[7]All but three cases in each group required hospitalization
[8]Based on women without cataracts at baseline (6,230-Placebo, 6,199-NOLVADEX)
[9]All women (6,707-Placebo, 6,681-NOLVADEX)
[10]Updated long-term follow-up data (median 6.9 years) from NSABP P-1 study added after cut-off for the other information in this table.

Table 4 describes the characteristics of the breast cancers in the NSABP P-1 trial and includes tumor size, nodal status, ER status. NOLVADEX decreased the incidence of small estrogen receptor positive tumors, but did not alter the incidence of estrogen receptor negative tumors or larger tumors.

Table 4. Characteristics of Breast Cancer in NSABP P-1 Trial

Staging Parameter	**Placebo N=156**	**Tamoxifen N=86**	**Total N=242**
Tumor Size:			
T1	117	60	177
T2	28	20	48
T3	7	3	10
T4	1	2	3
Unknown	3	1	4
Nodal status:			
Negative	103	56	159
1-3 positive nodes	29	14	43
≥ 4 positive nodes	10	12	22
Unknown	14	4	18
Stage:			
I	88	47	135
II: node negative	15	9	24
II: node positive	33	22	55
III	6	4	10

IV	2[1]	1	3
Unknown	12	3	15
Estrogen receptor:			
Positive	115	38	153
Negative	27	36	63
Unknown	14	12	26

[1]One participant presented with a suspicious bone scan but did not have documented metastases. She subsequently died of metastatic breast cancer.

Interim results from 2 trials in addition to the NSABP P-1 trial examining the effects of tamoxifen in reducing breast cancer incidence have been reported.

The first was the Italian Tamoxifen Prevention trial. In this trial women between the ages of 35 and 70, who had had a total hysterectomy, were randomized to receive 20 mg tamoxifen or matching placebo for 5 years. The primary endpoints were occurrence of, and death from, invasive breast cancer. Women without any specific risk factors for breast cancer were to be entered. Between 1992 and 1997, 5408 women were randomized. Hormone Replacement Therapy (HRT) was used in 14% of participants. The trial closed in 1997 due to the large number of dropouts during the first year of treatment (26%). After 46 months of follow-up there were 22 breast cancers in women on placebo and 19 in women on tamoxifen. Although no decrease in breast cancer incidence was observed, there was a trend for a reduction in breast cancer among women receiving protocol therapy for at least 1 year (19-placebo, 11- tamoxifen). The small numbers of participants along with the low level of risk in this otherwise healthy group precluded an adequate assessment of the effect of tamoxifen in reducing the incidence of breast cancer.

The second trial, the Royal Marsden Trial (RMT) was reported as an interim analysis. The RMT was begun in 1986 as a feasibility study of whether larger scale trials could be mounted. The trial was subsequently extended to a pilot trial to accrue additional participants to further assess the safety of tamoxifen. Twenty-four hundred and seventy-one women were entered between 1986 and 1996; they were selected on the basis of a family history of breast cancer. HRT was used in 40% of participants. In this trial, with a 70 month median follow-up, 34 and 36 breast cancers (8 noninvasive, 4 on each arm) were observed among women on tamoxifen and placebo, respectively. Patients in this trial were younger than those in the NSABP P-1 trial and may have been more likely to develop ER (-) tumors, which are unlikely to be reduced in number by tamoxifen therapy. Although women were selected on the basis of family history and were thought to have a high risk of breast cancer, few events occurred, reducing the statistical power of the study. These factors are potential reasons why the RMT may not have provided an adequate assessment of the effectiveness of tamoxifen in reducing the incidence of breast cancer.

In these trials, an increased number of cases of deep vein thrombosis, pulmonary embolus, stroke, and endometrial cancer were observed on the tamoxifen arm compared to the placebo arm. The frequency of events was consistent with the safety data observed in the NSABP P-1 trial.

McCune-Albright Syndrome:

A single, uncontrolled multicenter trial of NOLVADEX 20 mg once a day was conducted in a heterogenous group of girls with McCune-Albright Syndrome and precocious puberty manifested by physical signs of pubertal development, episodes of vaginal bleeding and/or advanced bone age (bone age of at least 12 months beyond chronological age). Twenty-eight female pediatric patients, aged 2 to 10 years, were treated for up to 12 months. Effect of treatment on frequency of vaginal bleeding, bone age advancement, and linear growth rate was assessed relative to prestudy baseline. NOLVADEX treatment was associated with a 50% reduction in frequency of vaginal bleeding episodes by patient or family report (mean annualized frequency of 3.56 episodes at baseline and 1.73 episodes on-treatment). Among the patients who reported vaginal bleeding during the pre-study period, 62% (13 out of 21 patients) reported no bleeding for a 6-month period and 33% (7 out of 21 patients) reported no vaginal bleeding for the duration of the trial. Not all patients improved on treatment and a few patients not reporting vaginal bleeding in the 6 months prior to enrollment reported menses on treatment. NOLVADEX therapy was associated with a reduction in mean rate of increase of bone age. Individual responses with regard to bone age advancement were highly heterogeneous. Linear growth rate was reduced during the course of NOLVADEX treatment in a majority of patients (mean change of 1.68 cm/year relative to baseline; change from 7.47 cm/year at baseline to 5.79 cm/year on study). This change was not uniformly seen across all stages of bone maturity; all recorded response failures occurred in patients with bone ages less than 7 years at screening.

Mean uterine volume increased after 6 months of treatment and doubled at the end of the one-year study. A causal relationship has not been established; however, as an increase in the incidence of endometrial adenocarcinoma and uterine sarcoma has been noted in adults treated with NOLVADEX (see **BOXED WARNING**), continued monitoring of McCune-Albright patients treated with NOLVADEX for long-term uterine effects is recommended. **The safety and efficacy of NOLVADEX for girls aged two to 10 years with McCune-Albright Syndrome and precocious puberty have not been studied beyond one year of treatment. The long-term effects of NOLVADEX therapy in girls have not been established.**

INDICATIONS AND USAGE

Metastatic Breast Cancer:

NOLVADEX is effective in the treatment of metastatic breast cancer in women and men. In premenopausal women with metastatic breast cancer, NOLVADEX is an alternative to oophorectomy or ovarian irradiation. Available evidence indicates that patients whose tumors are estrogen receptor positive are more likely to benefit from NOLVADEX therapy.

Adjuvant Treatment of Breast Cancer:

NOLVADEX is indicated for the treatment of node-positive breast cancer in postmenopausal women following total mastectomy or segmental mastectomy, axillary dissection, and breast irradiation. In some NOLVADEX adjuvant studies, most of the benefit to date has been in the subgroup with four or more positive axillary nodes.

NOLVADEX is indicated for the treatment of axillary node-negative breast cancer in women following total mastectomy or segmental mastectomy, axillary dissection, and breast irradiation.

The estrogen and progesterone receptor values may help to predict whether adjuvant NOLVADEX therapy is likely to be beneficial.

NOLVADEX reduces the occurrence of contralateral breast cancer in patients receiving adjuvant NOLVADEX therapy for breast cancer.

Ductal Carcinoma in Situ (DCIS):

In women with DCIS, following breast surgery and radiation, NOLVADEX is indicated to reduce the risk of invasive breast cancer (see **BOXED WARNING** at the beginning of the label). The decision regarding therapy with NOLVADEX for the reduction in breast cancer incidence should be based upon an individual assessment of the benefits and risks of NOLVADEX therapy.

Current data from clinical trials support five years of adjuvant NOLVADEX therapy for patients with breast cancer.

Reduction in Breast Cancer Incidence in High Risk Women:

NOLVADEX is indicated to reduce the incidence of breast cancer in women at high risk for breast cancer. This effect was shown in a study of 5 years planned duration with a median follow-up of 4.2 years. Twenty-five percent of the participants received drug for 5 years. The longer-term effects are not known. In this study, there was no impact of tamoxifen on overall or breast cancer-related mortality (see **BOXED WARNING** at the beginning of the label).

NOLVADEX is indicated only for high-risk women. "High risk" is defined as women at least 35 years of age with a 5-year predicted risk of breast cancer $\geq 1.67\%$, as calculated by the Gail Model.

Examples of combinations of factors predicting a 5-year risk $\geq 1.67\%$ are:

Age 35 or older and any of the following combination of factors:

- One first degree relative with a history of breast cancer, 2 or more benign biopsies, and a history of a breast biopsy showing atypical hyperplasia; or
- At least 2 first degree relatives with a history of breast cancer, and a personal history of at least one breast biopsy; or
- LCIS

Age 40 or older and any of the following combination of factors:

- One first degree relative with a history of breast cancer, 2 or more benign biopsies, age at first live birth 25 or older, and age at menarche 11 or younger; or
- At least 2 first degree relatives with a history of breast cancer, and age at first live birth 19 or younger; or
- One first degree relative with a history of breast cancer, and a personal history of a breast biopsy showing atypical hyperplasia.

Age 45 or older and any of the following combination of factors:

- At least 2 first degree relatives with a history of breast cancer and age at first live birth 24 or younger; or
- One first degree relative with a history of breast cancer with a personal history of a benign breast biopsy, age at menarche 11 or less and age at first live birth 20 or more.

Age 50 or older and any of the following combination of factors:

- At least 2 first degree relatives with a history of breast cancer; or
- History of one breast biopsy showing atypical hyperplasia, and age at first live birth 30 or older and age at menarche 11 or less; or
- History of at least two breast biopsies with a history of atypical hyperplasia, and age at first live birth 30 or more.

Age 55 or older and any of the following combination of factors:

- One first degree relative with a history of breast cancer with a personal history of a benign breast biopsy, and age at menarche 11 or less; or
- History of at least 2 breast biopsies with a history of atypical hyperplasia, and age at first live birth 20 or older.

Age 60 or older and:

- 5-year predicted risk of breast cancer $\geq$ 1.67%, as calculated by the Gail Model.

For women whose risk factors are not described in the above examples, the Gail Model is necessary to estimate absolute breast cancer risk. Health Care Professionals can obtain a Gail Model Risk Assessment Tool by dialing 1-800-544-2007.

There are insufficient data available regarding the effect of NOLVADEX on breast cancer incidence in women with inherited mutations (BRCA1, BRCA2) to be able to make specific recommendations on the effectiveness of NOLVADEX in these patients.

After an assessment of the risk of developing breast cancer, the decision regarding therapy with NOLVADEX for the reduction in breast cancer incidence should be based upon an individual assessment of the benefits and risks of NOLVADEX therapy. In the NSABP P-1 trial, NOLVADEX treatment lowered the risk of developing breast cancer during the follow-up period of the trial, but did not eliminate breast cancer risk (See Table 3 in **CLINICAL PHARMACOLOGY**).

CONTRAINDICATIONS

NOLVADEX is contraindicated in patients with known hypersensitivity to the drug or any of its ingredients.

Reduction in Breast Cancer Incidence in High Risk Women and Women with DCIS:

NOLVADEX is contraindicated in women who require concomitant coumarin-type anticoagulant therapy or in women with a history of deep vein thrombosis or pulmonary embolus.

WARNINGS

Effects in Metastatic Breast Cancer Patients:

As with other additive hormonal therapy (estrogens and androgens), hypercalcemia has been reported in some breast cancer patients with bone metastases within a few weeks of starting treatment with NOLVADEX. If hypercalcemia does occur, appropriate measures should be taken and, if severe, NOLVADEX should be discontinued.

Effects on the Uterus-Endometrial Cancer and Uterine Sarcoma:

An increased incidence of uterine malignancies has been reported in association with NOLVADEX treatment. The underlying mechanism is unknown, but may be related to the estrogen-like effect of NOLVADEX. Most uterine malignancies seen in association with NOLVADEX are classified as adenocarcinoma of the endometrium. However, rare uterine sarcomas, including malignant mixed mullerian tumors, have also been reported. Uterine sarcoma is generally associated with a higher FIGO stage (III/IV) at diagnosis, poorer prognosis, and shorter survival. Uterine sarcoma has been reported to occur more frequently among long-term users (≥ 2 years) of NOLVADEX than non-users. Some of the uterine malignancies (endometrial carcinoma or uterine sarcoma) have been fatal.

In the NSABP P-1 trial, among participants randomized to NOLVADEX there was a statistically significant increase in the incidence of endometrial cancer (33 cases of invasive endometrial cancer, compared to 14 cases among participants randomized to placebo (RR=2.48, 95% CI: 1.27-4.92). The 33 cases in participants receiving NOLVADEX were FIGO Stage I, including 20 IA, 12 IB, and 1 IC endometrial adenocarcinomas. In participants randomized to placebo, 13 were FIGO Stage I (8 IA and 5 IB) and 1 was FIGO Stage IV. Five women on NOLVADEX and 1 on placebo received postoperative radiation therapy in addition to surgery. This increase was primarily observed among women at least 50 years of age at the time of randomization (26 cases of invasive endometrial cancer, compared to 6 cases among participants randomized to placebo (RR=4.50, 95% CI: 1.78-13.16). Among women ≤ 49 years of age at the time of randomization there were 7 cases of invasive endometrial cancer, compared to 8 cases among participants randomized to placebo (RR=0.94, 95% CI: 0.28-2.89). If age at the time of diagnosis is considered, there were 4 cases of endometrial cancer among participants ≤ 49 randomized to NOLVADEX compared to 2 among participants randomized to placebo (RR=2.21, 95% CI: 0.4-12.0). For women ≥ 50 at the time of diagnosis, there were 29 cases among participants randomized to NOLVADEX compared to 12 among women on placebo (RR=2.5, 95% CI: 1.3-4.9). The risk ratios were similar in the two groups, although fewer events occurred in younger women. Most (29 of 33 cases in the NOLVADEX group) endometrial cancers were diagnosed in symptomatic women, although 5 of 33 cases in the NOLVADEX group occurred in asymptomatic women. Among women receiving NOLVADEX the events appeared between 1 and 61 months (average=32 months) from the start of treatment.

In an updated review of long-term data (median length of total follow-up is 6.9 years, including blinded follow-up) on 8,306 women with an intact uterus at randomization in the NSABP P-1 risk reduction trial, the incidence of both adenocarcinomas and rare uterine sarcomas was increased in women taking NOLVADEX. During blinded follow-up, there were 36 cases of FIGO Stage I endometrial adenocarcinoma (22 were FIGO Stage IA, 13 IB, and 1 IC) in women receiving NOLVADEX and 15 cases in women receiving placebo [14 were FIGO Stage I (9 IA and 5 IB), and 1 case was FIGO Stage IV]. Of the patients receiving NOLVADEX who developed endometrial cancer, one with Stage IA and 4 with Stage IB cancers received radiation therapy. In the placebo group, one patient with FIGO Stage 1B cancer received radiation therapy and the patient with FIGO Stage IVB cancer received chemotherapy and hormonal therapy. During total follow-up, endometrial adenocarcinoma was reported in 53 women randomized to NOLVADEX (30 cases of FIGO Stage IA, 20 were Stage IB, 1 was Stage IC, and 2 were Stage IIIC), and 17 women randomized to placebo (9 cases were FIGO Stage IA, 6 were Stage IB, 1 was Stage IIIC, and 1 was Stage IVB) (incidence per 1,000 women-years of 2.20 and 0.71, respectively). Some patients received post-operative radiation therapy in addition to surgery. Uterine sarcomas were reported in 4 women randomized to NOLVADEX (1 was FIGO IA, 1 was FIGO IB, 1 was FIGO IIA, and 1 was FIGO IIIC) and one patient randomized to placebo (FIGO 1A); incidence per 1,000 women-years of 0.17 and 0.04, respectively. Of the patients randomized to NOLVADEX, the FIGO IA and IB cases were a MMMT and sarcoma, respectively; the FIGO II was a MMMT; and the FIGO III was a sarcoma; and the one patient randomized to placebo had a MMMT. A similar increased incidence in endometrial adenocarcinoma and uterine sarcoma was observed among women receiving NOLVADEX in five other NSABP clinical trials.

Any patient receiving or who has previously received NOLVADEX who reports abnormal vaginal bleeding should be promptly evaluated. Patients receiving or who have previously received NOLVADEX should have annual gynecological examinations and they should promptly inform their physicians if they experience any abnormal gynecological symptoms, eg, menstrual irregularities, abnormal vaginal bleeding, changes in vaginal discharge, or pelvic pain or pressure.

In the P-1 trial, endometrial sampling did not alter the endometrial cancer detection rate compared to women who did not undergo endometrial sampling (0.6% with sampling, 0.5% without sampling) for women with an intact uterus. There are no data to suggest that routine endometrial sampling in asymptomatic women taking NOLVADEX to reduce the incidence of breast cancer would be beneficial.

Non-Malignant Effects on the Uterus:

An increased incidence of endometrial changes including hyperplasia and polyps have been reported in association with NOLVADEX treatment. The incidence and pattern of this increase suggest that the underlying mechanism is related to the estrogenic properties of NOLVADEX.

There have been a few reports of endometriosis and uterine fibroids in women receiving NOLVADEX. The underlying mechanism may be due to the partial estrogenic effect of NOLVADEX. Ovarian cysts have also been observed in a small number of premenopausal patients with advanced breast cancer who have been treated with NOLVADEX.

NOLVADEX has been reported to cause menstrual irregularity or amenorrhea.

Thromboembolic Effects of NOLVADEX:

There is evidence of an increased incidence of thromboembolic events, including deep vein thrombosis and pulmonary embolism, during NOLVADEX therapy. When NOLVADEX is coadminstered with chemotherapy, there may be a further increase in the incidence of thromboembolic effects. For treatment of breast cancer, the risks and benefits of NOLVADEX should be carefully considered in women with a history of thromboembolic events.

Data from the NSABP P-1 trial show that participants receiving NOLVADEX without a history of pulmonary emboli (PE) had a statistically significant increase in pulmonary emboli (18-NOLVADEX, 6-placebo, RR=3.01, 95% CI: 1.15- 9.27). Three of the pulmonary emboli, all in the NOLVADEX arm, were fatal. Eighty-seven percent of the cases of pulmonary embolism occurred in women at least 50 years of age at randomization. Among women receiving NOLVADEX, the events appeared between 2 and 60 months (average=27 months) from the start of treatment.

In this same population, a non-statistically significant increase in deep vein thrombosis (DVT) was seen in the NOLVADEX group (30-NOLVADEX, 19-placebo; RR=1.59, 95% CI: 0.86-2.98). The same increase in relative risk was seen in women ≤ 49 and in women ≥ 50, although fewer events occurred in younger women. Women with thromboembolic events were at risk for a second related event (7 out of 25 women on placebo, 5 out of 48 women on NOLVADEX) and were at risk for complications of the event and its treatment (0/25 on placebo, 4/48 on NOLVADEX). Among women receiving NOLVADEX, deep vein thrombosis events occurred between 2 and 57 months (average=19 months) from the start of treatment.

There was a non-statistically significant increase in stroke among patients randomized to NOLVADEX (24-Placebo; 34-NOLVADEX; RR=1.42; 95% CI 0.82-2.51). Six of the 24 strokes in the placebo group were considered hemorrhagic in origin and 10 of the 34 strokes in the NOLVADEX group were categorized as hemorrhagic. Seventeen of the 34 strokes in the NOLVADEX group were considered occlusive and 7 were considered to be of unknown etiology. Fourteen of the 24 strokes on the placebo arm were reported to be occlusive and 4 of unknown etiology. Among these strokes 3 strokes in the placebo group and 4 strokes in the NOLVADEX group were fatal. Eighty-eight percent of the strokes occurred in women at least 50 years of age at the time of randomization. Among women receiving NOLVADEX, the events occurred between 1 and 63 months (average=30 months) from the start of treatment.

Effects on the liver: Liver cancer:

In the Swedish trial using adjuvant NOLVADEX 40 mg/day for 2-5 years, 3 cases of liver cancer have been reported in the NOLVADEX-treated group vs. 1 case in the observation group (See **PRECAUTIONS- Carcinogenesis**). In other clinical trials evaluating NOLVADEX, no cases of liver cancer have been reported to date.

One case of liver cancer was reported in NSABP P-1 in a participant randomized to NOLVADEX.

Effects on the liver: Non-malignant effects:

NOLVADEX has been associated with changes in liver enzyme levels, and on rare occasions, a spectrum of more severe liver abnormalities including fatty liver, cholestasis, hepatitis and hepatic necrosis. A few of these serious cases included fatalities. In most reported cases the relationship to NOLVADEX is uncertain. However, some positive rechallenges and dechallenges have been reported.

In the NSABP P-1 trial, few grade 3-4 changes in liver function (SGOT, SGPT, bilirubin, alkaline phosphatase) were observed (10 on placebo and 6 on NOLVADEX). Serum lipids were not systematically collected.

Other cancers:

A number of second primary tumors, occurring at sites other than the endometrium, have been reported following the treatment of breast cancer with NOLVADEX in clinical trials. Data from the NSABP B-14 and P-1 studies show no increase in other (non-uterine) cancers among patients receiving NOLVADEX. Whether an increased risk for other (non-uterine) cancers is associated with NOLVADEX is still uncertain and continues to be evaluated.

Effects on the Eye:

Ocular disturbances, including corneal changes, decrement in color vision perception, retinal vein thrombosis, and retinopathy have been reported in patients receiving NOLVADEX. An increased incidence of cataracts and the need for cataract surgery have been reported in patients receiving NOLVADEX.

In the NSABP P-1 trial, an increased risk of borderline significance of developing cataracts among those women without cataracts at baseline (540-NOLVADEX; 483-placebo; RR=1.13, 95% CI: 1.00-1.28) was observed. Among these same women, NOLVADEX was associated with an increased risk of having cataract surgery (101-NOLVADEX; 63-placebo; RR=1.62, 95% CI 1.18-2.22) (See Table 3 in **CLINICAL PHARMACOLOGY**). Among all women on the trial (with or without cataracts at baseline), NOLVADEX was associated with an increased risk of having cataract surgery (201-NOLVADEX; 129-placebo; RR=1.58, 95% CI 1.26-1.97). Eye examinations were not required during the study. No other conclusions regarding non-cataract ophthalmic events can be made.

Pregnancy Category D:

NOLVADEX may cause fetal harm when administered to a pregnant woman. Women should be advised not to become pregnant while taking NOLVADEX or within 2 months of discontinuing NOLVADEX and should use barrier or nonhormonal contraceptive measures if sexually active. Tamoxifen does not cause infertility, even in the presence of menstrual irregularity. Effects on reproductive functions are expected from the antiestrogenic properties of the drug. In reproductive studies in rats at dose levels equal to or below the human dose, nonteratogenic developmental skeletal changes were seen and were found reversible. In addition, in fertility studies in rats and in teratology studies in rabbits using doses at or below those used in humans, a lower incidence of embryo implantation and a higher incidence of fetal death or retarded in utero growth were observed, with slower learning behavior in some rat pups when compared to historical controls. Several pregnant marmosets were dosed with 10 mg/kg/day (about 2-fold the daily maximum recommended human dose on a mg/m^2 basis) during organogenesis or in the last half of pregnancy. No deformations were seen and, although the dose was high enough to terminate pregnancy in some animals, those that did maintain pregnancy showed no evidence of teratogenic malformations.

In rodent models of fetal reproductive tract development, tamoxifen (at doses 0.002 to 2.4-fold the daily maximum recommended human dose on a mg/m^2 basis) caused changes in both sexes that are similar to those caused by estradiol, ethynylestradiol and diethylstilbestrol. Although the clinical relevance of these changes is unknown, some of these changes, especially vaginal adenosis, are similar to those seen in young women who were exposed to diethylstilbestrol in utero and who have a 1 in 1000 risk of developing clear-cell adenocarcinoma of the vagina or cervix. To date, in utero exposure to tamoxifen has not been shown to cause vaginal adenosis, or clear-cell adenocarcinoma of the vagina or cervix, in young women. However, only a small number of young women have been exposed to tamoxifen in utero, and a smaller number have been followed long enough (to age 15-20) to determine whether vaginal or cervical neoplasia could occur as a result of this exposure.

There are no adequate and well-controlled trials of tamoxifen in pregnant women. There have been a small number of reports of vaginal bleeding, spontaneous abortions, birth defects, and fetal deaths in pregnant women. If this drug is used during pregnancy, or the patient becomes pregnant while taking this drug, or within approximately two months after discontinuing therapy, the patient should be apprised of the potential risks to the fetus including the potential long-term risk of a DES-like syndrome.

Reduction in Breast Cancer Incidence in High Risk Women - Pregnancy Category D:

For sexually active women of child-bearing potential, NOLVADEX therapy should be initiated during menstruation. In women with menstrual irregularity, a negative B-HCG immediately prior to the initiation of therapy is sufficient (See **PRECAUTIONS-Information for Patients - Reduction in Breast Cancer Incidence in High Risk Women**).

PRECAUTIONS

General:

Decreases in platelet counts, usually to 50,000-100,000/mm^3, infrequently lower, have been occasionally reported in patients taking NOLVADEX for breast cancer. In patients with significant thrombocytopenia, rare hemorrhagic episodes have occurred, but it is uncertain if these episodes are due to NOLVADEX therapy. Leukopenia has been observed, sometimes in association with anemia and/or thrombocytopenia. There have been rare reports of neutropenia and pancytopenia in patients receiving NOLVADEX; this can sometimes be severe.

In the NSABP P-1 trial, 6 women on NOLVADEX and 2 on placebo experienced grade 3-4 drops in platelet counts (≤50,000/mm^3).

Information for Patients:

Patients should be instructed to read the Medication Guide supplied as required by law when NOLVADEX is dispensed. The complete text of the Medication Guide is reprinted at the end of this document.

Reduction in Invasive Breast Cancer and DCIS in Women with DCIS:

Women with DCIS treated with lumpectomy and radiation therapy who are considering NOLVADEX to reduce the incidence of a second breast cancer event should assess the risks and benefits of therapy, since treatment with NOLVADEX decreased the incidence of invasive breast cancer, but has not been shown to affect survival (See Table 1 in **CLINICAL PHARMACOLOGY**).

Reduction in Breast Cancer Incidence in High Risk Women:

Women who are at high risk for breast cancer can consider taking NOLVADEX therapy to reduce the incidence of breast cancer. Whether the benefits of treatment are considered to outweigh the risks depends on a woman's personal health history and on how she weighs the benefits and risks. NOLVADEX therapy to reduce the incidence of breast cancer may therefore not be appropriate for all women at high risk for breast cancer. Women who are considering NOLVADEX therapy should consult their health care professional for an assessment of the potential benefits and risks prior to starting therapy for reduction in breast cancer incidence (See Table 3 in **CLINICAL PHARMACOLOGY**). Women should understand that NOLVADEX reduces the incidence of breast cancer, but may not eliminate risk. NOLVADEX decreased the incidence of small estrogen receptor positive tumors, but did not alter the incidence of estrogen receptor negative tumors or larger tumors. In women with breast cancer who are at high risk of developing a second breast cancer, treatment with about 5 years of NOLVADEX reduced the annual incidence rate of a second breast cancer by approximately 50%.

Women who are pregnant or who plan to become pregnant should not take NOLVADEX to reduce her risk of breast cancer. Effective nonhormonal contraception must be used by all premenopausal women taking NOLVADEX and for approximately two months after discontinuing therapy if they are sexually active. Tamoxifen does not cause infertility, even in the presence of menstrual irregularity. For sexually active women of child-bearing potential, NOLVADEX therapy should be initiated during menstruation. In women with menstrual irregularity, a negative B-HCG immediately prior to the initiation of therapy is sufficient (See **WARNINGS-Pregnancy Category D**).

Two European trials of tamoxifen to reduce the risk of breast cancer were conducted and showed no difference in the number of breast cancer cases between the tamoxifen and placebo arms. These studies had trial designs that differed from that of NSABP P-1, were smaller than NSABP P-1, and enrolled women at a lower risk for breast cancer than those in P-1.

Monitoring During NOLVADEX Therapy:

Women taking or having previously taken NOLVADEX should be instructed to seek prompt medical attention for new breast lumps, vaginal bleeding, gynecologic symptoms (menstrual irregularities, changes in vaginal discharge, or pelvic pain or pressure), symptoms of leg swelling or tenderness, unexplained shortness of breath, or changes in vision. Women should inform all care providers, regardless of the reason for evaluation, that they take NOLVADEX.

Women taking NOLVADEX to reduce the incidence of breast cancer should have a breast examination, a mammogram, and a gynecologic examination prior to the initiation of therapy. These studies should be repeated at regular intervals while on therapy, in keeping with good medical practice. Women taking NOLVADEX as adjuvant breast cancer therapy should follow the same monitoring procedures as for women taking NOLVADEX for the reduction in the incidence of breast cancer. Women taking NOLVADEX as treatment for metastatic breast cancer should review this monitoring plan with their care provider and select the appropriate modalities and schedule of evaluation.

Laboratory Tests:

Periodic complete blood counts, including platelet counts, and periodic liver function tests should be obtained.

Drug Interactions:

When NOLVADEX is used in combination with coumarin-type anticoagulants, a significant increase in anticoagulant effect may occur. Where such coadministration exists, careful monitoring of the patient's prothrombin time is recommended.

In the NSABP P-1 trial, women who required coumarin-type anticoagulants for any reason were ineligible for participation in the trial (See **CONTRAINDICATIONS**).

There is an increased risk of thromboembolic events occurring when cytotoxic agents are used in combination with NOLVADEX.

Tamoxifen reduced letrozole plasma concentrations by 37%. The effect of tamoxifen on metabolism and excretion of other antineoplastic drugs, such as cyclophosphamide and other drugs that require mixed function oxidases for activation, is not known. Tamoxifen and N-desmethyl tamoxifen plasma concentrations have been shown to be reduced when coadministered with rifampin or aminoglutethimide. Induction of CYP3A4-mediated metabolism is considered to be the mechanism by which these reductions occur; other CYP3A4 inducing agents have not been studied to confirm this effect.

One patient receiving NOLVADEX with concomitant phenobarbital exhibited a steady state serum level of tamoxifen lower than that observed for other patients (ie, 26 ng/mL vs. mean value of 122 ng/mL). However, the clinical significance of this finding is not known. Rifampin induced the metabolism of tamoxifen and significantly reduced the plasma concentrations of tamoxifen in 10 patients. Aminoglutethimide reduces tamoxifen and N-desmethyl tamoxifen plasma concentrations. Medroxyprogesterone reduces plasma concentrations of N-desmethyl, but not tamoxifen.

Concomitant bromocriptine therapy has been shown to elevate serum tamoxifen and N-desmethyl tamoxifen.

Drug/Laboratory Testing Interactions:

During postmarketing surveillance, T4 elevations were reported for a few postmenopausal patients which may be explained by increases in thyroid-binding globulin. These elevations were not accompanied by clinical hyperthyroidism.

Variations in the karyopyknotic index on vaginal smears and various degrees of estrogen effect on Pap smears have been infrequently seen in postmenopausal patients given NOLVADEX.

In the postmarketing experience with NOLVADEX, infrequent cases of hyperlipidemias have been reported. Periodic monitoring of plasma triglycerides and cholesterol may be indicated in patients with pre-existing hyperlipidemias (See **ADVERSE REACTIONS-Postmarketing experience** section).

Carcinogenesis:

A conventional carcinogenesis study in rats at doses of 5, 20, and 35 mg/kg/day (about one, three and seven-fold the daily maximum recommended human dose on a mg/m^2 basis) administered by oral gavage for up to 2 years) revealed a significant increase in hepatocellular carcinoma at all doses. The incidence of these tumors was significantly greater among rats administered 20 or 35 mg/kg/day (69%) compared to those administered 5 mg/kg/day (14%). In a separate study, rats were administered tamoxifen at 45 mg/kg/day (about nine-fold the daily maximum recommended human dose on a mg/m^2 basis); hepatocellular neoplasia was exhibited at 3 to 6 months.

Granulosa cell ovarian tumors and interstitial cell testicular tumors were observed in two separate mouse studies. The mice were administered the trans and racemic forms of tamoxifen for 13 to 15 months at doses of 5, 20 and 50 mg/kg/day (about one-half, two and five-fold the daily recommended human dose on a mg/m^2 basis).

Mutagenesis:
No genotoxic potential was found in a conventional battery of *in vivo* and *in vitro* tests with pro- and eukaryotic test systems with drug metabolizing systems. However, increased levels of DNA adducts were observed by ^{32}P post-labeling in DNA from rat liver and cultured human lymphocytes. Tamoxifen also has been found to increase levels of micronucleus formation *in vitro* in human lymphoblastoid cell line (MCL-5). Based on these findings, tamoxifen is genotoxic in rodent and human MCL-5 cells.

Impairment of Fertility:
Tamoxifen produced impairment of fertility and conception in female rats at doses of 0.04 mg/kg/day (about 0.01-fold the daily maximum recommended human dose on a mg/m^2 basis) when dosed for two weeks prior to mating through day 7 of pregnancy. At this dose, fertility and reproductive indices were markedly reduced with total fetal mortality. Fetal mortality was also increased at doses of 0.16 mg/kg/day (about 0.03-fold the daily maximum recommended human dose on a mg/m^2 basis) when female rats were dosed from days 7-17 of pregnancy. Tamoxifen produced abortion, premature delivery and fetal death in rabbits administered doses equal to or greater than 0.125 mg/kg/day (about 0.05-fold the daily maximum recommended human dose on a mg/m^2 basis). There were no teratogenic changes in either rats or rabbits.

Pregnancy Category D:
See **WARNINGS**.

Nursing Mothers:
It is not known whether this drug is excreted in human milk. Because many drugs are excreted in human milk and because of the potential for serious adverse reactions in nursing infants from NOLVADEX, a decision should be made whether to discontinue nursing or to discontinue the drug, taking into account the importance of the drug to the mother.

Pediatric Use:
The safety and efficacy of NOLVADEX for girls aged two to 10 years with McCune-Albright Syndrome and precocious puberty have not been studied beyond one year of treatment. The long-term effects of NOLVADEX therapy for girls have not been established. In adults treated with NOLVADEX, an increase in incidence of uterine malignancies, stroke and pulmonary embolism has been noted (see **BOXED WARNING**, and **CLINICAL PHARMACOLOGY-Clinical Studies-McCune-Albright Syndrome** subsection).

Geriatric Use:
In the NSABP P-1 trial, the percentage of women at least 65 years of age was 16%. Women at least 70 years of age accounted for 6% of the participants. A reduction in breast cancer incidence was seen among participants in each of the subsets: A total of 28 and 10 invasive breast cancers were seen among participants 65 and older in the placebo and NOLVADEX groups, respectively. Across all other outcomes, the results in this subset reflect the results observed in the subset of women at least 50 years of age. No overall differences in tolerability were observed between older and younger patients (See **CLINICAL PHARMACOLOGY - Clinical Studies - Reduction in Breast Cancer Incidence in High Risk Women** section).

In the NSABP B-24 trial, the percentage of women at least 65 years of age was 23%. Women at least 70 years of age accounted for 10% of participants. A total of 14 and 12 invasive breast cancers were seen among participants 65 and older in the placebo and NOLVADEX groups, respectively. This subset is too small to reach any conclusions on efficacy. Across all other endpoints, the results in this subset were comparable to those of younger women enrolled in this trial. No overall differences in tolerability were observed between older and younger patients.

ADVERSE REACTIONS

Adverse reactions to NOLVADEX are relatively mild and rarely severe enough to require discontinuation of treatment in breast cancer patients.

Continued clinical studies have resulted in further information which better indicates the incidence of adverse reactions with NOLVADEX as compared to placebo.

Metastatic Breast Cancer:

Increased bone and tumor pain and, also, local disease flare have occurred, which are sometimes associated with a good tumor response. Patients with increased bone pain may require additional analgesics. Patients with soft tissue disease may have sudden increases in the size of preexisting lesions, sometimes associated with marked erythema within and surrounding the lesions and/or the development of new lesions. When they occur, the bone pain or disease flare are seen shortly after starting NOLVADEX and generally subside rapidly.

In patients treated with NOLVADEX for metastatic breast cancer, the most frequent adverse reaction to NOLVADEX is hot flashes.

Other adverse reactions which are seen infrequently are hypercalcemia, peripheral edema, distaste for food, pruritus vulvae, depression, dizziness, light-headedness, headache, hair thinning and/or partial hair loss, and vaginal dryness.

Premenopausal Women:

The following table summarizes the incidence of adverse reactions reported at a frequency of 2% or greater from clinical trials (Ingle, Pritchard, Buchanan) which compared NOLVADEX therapy to ovarian ablation in premenopausal patients with metastatic breast cancer.

Adverse Reactions*	NOLVADEX All Effects % of Women n=104	OVARIAN ABLATION All Effects % of Women n=100
Flush	33	46
Amenorrhea	16	69
Altered Menses	13	5
Oligomenorrhea	9	1
Bone Pain	6	6
Menstrual Disorder	6	4
Nausea	5	4

Cough/Coughing	4	1
Edema	4	1
Fatigue	4	1
Muscoloskeletal Pain	3	0
Pain	3	4
Ovarian Cyst(s)	3	2
Depression	2	2
Abdominal Cramps	1	2
Anorexia	1	2

*Some women had more than one adverse reaction.

Male Breast Cancer:

NOLVADEX is well tolerated in males with breast cancer. Reports from the literature and case reports suggest that the safety profile of NOLVADEX in males is similar to that seen in women. Loss of libido and impotence have resulted in discontinuation of tamoxifen therapy in male patients. Also, in oligospermic males treated with tamoxifen, LH, FSH, testosterone and estrogen levels were elevated. No significant clinical changes were reported.

Adjuvant Breast Cancer:

In the NSABP B-14 study, women with axillary node-negative breast cancer were randomized to 5 years of NOLVADEX 20 mg/day or placebo following primary surgery. The reported adverse effects are tabulated below (mean follow-up of approximately 6.8 years) showing adverse events more common on NOLVADEX than on placebo. The incidence of hot flashes (64% vs. 48%), vaginal discharge (30% vs. 15%), and irregular menses (25% vs. 19%) were higher with NOLVADEX compared with placebo. All other adverse effects occurred with similar frequency in the 2 treatment groups, with the exception of thrombotic events; a higher incidence was seen in NOLVADEX-treated patients (through 5 years, 1.7% vs. 0.4%). Two of the patients treated with NOLVADEX who had thrombotic events died.

NSABP B-14 Study

Adverse Effect	% of Women NOLVADEX (n=1422)	% of Women Placebo (n=1437)
Hot Flashes	64	48
Fluid Retention	32	30
Vaginal Discharge	30	15
Nausea	26	24
Irregular Menses	25	19
Weight Loss (>5%)	23	18
Skin Changes	19	15
Increased SGOT	5	3
Increased Bilirubin	2	1
Increased Creatinine	2	1
Thrombocytopenia*	2	1
Thrombotic Events		

Deep Vein Thrombosis	0.8	0.2
Pulmonary Embolism	0.5	0.2
Superficial Phlebitis	0.4	0.0

*Defined as a platelet count of <100,000/mm^3

In the Eastern Cooperative Oncology Group (ECOG) adjuvant breast cancer trial, NOLVADEX or placebo was administered for 2 years to women following mastectomy. When compared to placebo, NOLVADEX showed a significantly higher incidence of hot flashes (19% vs. 8% for placebo). The incidence of all other adverse reactions was similar in the 2 treatment groups with the exception of thrombocytopenia where the incidence for NOLVADEX was 10% vs. 3% for placebo, an observation of borderline statistical significance.

In other adjuvant studies, Toronto and NOLVADEX Adjuvant Trial Organization (NATO), women received either NOLVADEX or no therapy. In the Toronto study, hot flashes were observed in 29% of patients for NOLVADEX vs. 1% in the untreated group. In the NATO trial, hot flashes and vaginal bleeding were reported in 2.8% and 2.0% of women, respectively, for NOLVADEX vs. 0.2% for each in the untreated group.

Ductal Carcinoma in Situ (DCIS):

The type and frequency of adverse events in the NSABP B-24 trial were consistent with those observed in the other adjuvant trials conducted with NOLVADEX.

Reduction in Breast Cancer Incidence in High Risk Women:

In the NSABP P-1 Trial, there was an increase in five serious adverse effects in the NOLVADEX group: endometrial cancer (33 cases in the NOLVADEX group vs. 14 in the placebo group); pulmonary embolism (18 cases in the NOLVADEX group vs. 6 in the placebo group); deep vein thrombosis (30 cases in the NOLVADEX group vs. 19 in the placebo group); stroke (34 cases in the NOLVADEX group vs. 24 in the placebo group); cataract formation (540 cases in the NOLVADEX group vs. 483 in the placebo group) and cataract surgery (101 cases in the NOLVADEX group vs. 63 in the placebo group) (See **WARNINGS** and Table 3 in **CLINICAL PHARMACOLOGY**).

The following table presents the adverse events observed in NSABP P-1 by treatment arm. Only adverse events more common on NOLVADEX than placebo are shown.

NSABP P-1 Trial: All Adverse Events
% of Women

	NOLVADEX N=6681	PLACEBO N=6707)
Self Reported Symptoms	N=6441[1]	N=6469[1]
Hot Flashes	80	68
Vaginal Discharges	55	35
Vaginal Bleeding	23	22
Laboratory Abnormalities	N=6520[2]	N=6535[2]
Platelets decreased	0.7	0.3

Adverse Effects	N=6492[3]	N=6484[3]
Other Toxicities		
Mood	11.6	10.8
Infection/Sepsis	6.0	5.1
Constipation	4.4	3.2
Alopecia	5.2	4.4
Skin	5.6	4.7
Allergy	2.5	2.1

[1]Number with Quality of Life Questionnaires
[2]Number with Treatment Follow-up Forms
[3]Number with Adverse Drug Reaction Forms

In the NSABP P-1 trial, 15.0% and 9.7% of participants receiving NOLVADEX and placebo therapy, respectively withdrew from the trial for medical reasons. The following are the medical reasons for withdrawing from NOLVADEX and placebo therapy, respectively: Hot flashes (3.1% vs. 1.5%) and Vaginal Discharge (0.5% vs. 0.1%).

In the NSABP P-1 trial, 8.7% and 9.6% of participants receiving NOLVADEX and placebo therapy, respectively withdrew for non-medical reasons.

On the NSABP P-1 trial, hot flashes of any severity occurred in 68% of women on placebo and in 80% of women on NOLVADEX. Severe hot flashes occurred in 28% of women on placebo and 45% of women on NOLVADEX. Vaginal discharge occurred in 35% and 55% of women on placebo and NOLVADEX respectively; and was severe in 4.5% and 12.3% respectively. There was no difference in the incidence of vaginal bleeding between treatment arms.

Pediatric Patients - McCune-Albright Syndrome:

Mean uterine volume increased after 6 months of treatment and doubled at the end of the one-year study. A causal relationship has not been established; however, as an increase in the incidence of endometrial adenocarcinoma and uterine sarcoma has been noted in adults treated with NOLVADEX (see **BOXED WARNING**), continued monitoring of McCune-Albright patients treated with NOLVADEX for long-term effects is recommended. **The safety and efficacy of NOLVADEX for girls aged two to 10 years with McCune-Albright Syndrome and precocious puberty have not been studied beyond one year to treatment. The long-term effects of NOLVADEX therapy in girls have not been established.**

Postmarketing experience:

Less frequently reported adverse reactions are vaginal bleeding, vaginal discharge, menstrual irregularities, skin rash and headaches. Usually these have not been of sufficient severity to require dosage reduction or discontinuation of treatment. Very rare reports of erythema multiforme, Stevens-Johnson syndrome, bullous pemphigoid, interstitial pneumonitis, and rare reports of hypersensitivity reactions including angioedema have been reported with NOLVADEX therapy. In some of these cases, the time to onset was more than one year. Rarely, elevation of serum triglyceride levels, in some cases with pancreatitis, may be associated with the use of NOLVADEX (see **PRECAUTIONS- Drug/Laboratory Testing Interactions** section).

OVERDOSAGE

Signs observed at the highest doses following studies to determine LD_{50} in animals were respiratory difficulties and convulsions.

Acute overdosage in humans has not been reported. In a study of advanced metastatic cancer patients which specifically determined the maximum tolerated dose of NOLVADEX in evaluating the use of very high doses to reverse multidrug resistance, acute neurotoxicity manifested by tremor, hyperreflexia, unsteady gait and dizziness were noted. These symptoms occurred within 3-5 days of beginning NOLVADEX and cleared within 2-5 days after stopping therapy. No permanent neurologic toxicity was noted. One patient experienced a seizure several days after NOLVADEX was discontinued and neurotoxic symptoms had resolved. The causal relationship of the seizure to NOLVADEX therapy is unknown. Doses given in these patients were all greater than 400 mg/m^2 loading dose, followed by maintenance doses of 150 mg/m^2 of NOLVADEX given twice a day.

In the same study, prolongation of the QT interval on the electrocardiogram was noted when patients were given doses higher than 250 mg/m^2 loading dose, followed by maintenance doses of 80 mg/m^2 of NOLVADEX given twice a day. For a woman with a body surface area of 1.5 m^2 the minimal loading dose and maintenance doses given at which neurological symptoms and QT changes occurred were at least 6 fold higher in respect to the maximum recommended dose.

No specific treatment for overdosage is known; treatment must be symptomatic.

DOSAGE AND ADMINISTRATION

For patients with breast cancer, the recommended daily dose is 20-40 mg. Dosages greater than 20 mg per day should be given in divided doses (morning and evening).

In three single agent adjuvant studies in women, one 10 mg NOLVADEX tablet was administered two (ECOG and NATO) or three (Toronto) times a day for two years. In the NSABP B-14 adjuvant study in women with node-negative breast cancer, one 10 mg NOLVADEX tablet was given twice a day for at least 5 years. Results of the B-14 study suggest that continuation of therapy beyond five years does not provide additional benefit (see **CLINICAL PHARMACOLOGY**). In the EBCTCG 1995 overview, the reduction in recurrence and mortality was greater in those studies that used tamoxifen for about 5 years than in those that used tamoxifen for a shorter period of therapy. There was no indication that doses greater than 20 mg per day were more effective. Current data from clinical trials support 5 years of adjuvant NOLVADEX therapy for patients with breast cancer.

Ductal Carcinoma in Situ (DCIS):

The recommended dose is NOLVADEX 20 mg daily for 5 years.

Reduction in Breast Cancer Incidence in High Risk Women:

The recommended dose is NOLVADEX 20 mg daily for 5 years. There are no data to support the use of NOLVADEX other than for 5 years (See **CLINICAL PHARMACOLOGY-Clinical Studies - Reduction in Breast Cancer Incidence in High Risk Women**).

HOW SUPPLIED

10 mg Tablets containing tamoxifen as the citrate in an amount equivalent to 10 mg of tamoxifen (round, biconvex, uncoated, white tablet identified with NOLVADEX 600 debossed on one side and a cameo debossed on the other side) are supplied in bottles of 60 tablets. NDC 0310-0600.

20 mg Tablets containing tamoxifen as the citrate in an amount equivalent to 20 mg of tamoxifen (round, biconvex, uncoated, white tablet identified with NOLVADEX 604 debossed on one side and a cameo debossed on the other side) are supplied in bottles of 30 tablets. NDC 0310-0604.

Store at controlled room temperature, 20-25°C (68-77°F) [see USP]. Dispense in a well-closed, light-resistant container.

MEDICATION GUIDE

NOLVADEX® (NOLE-vah-dex) Tablets
Generic name: tamoxifen (ta-MOX-I-fen)

Written for women who use NOLVADEX to lower their high chance of getting breast cancer or who have ductal carcinoma in situ (DCIS)

This Medication Guide discusses only the use of NOLVADEX to lower the chance of getting breast cancer in high-risk women and in women treated for DCIS.

People taking NOLVADEX **to treat** breast cancer have different benefits and different decisions to make than high-risk women or women with ductal carcinoma in situ (DCIS) taking NOLVADEX to reduce the chance of getting breast cancer. If you already have breast cancer, talk with your doctor about how the benefits of treating breast cancer with NOLVADEX compare to the risks that are described in this document.

Why should I read this Medication Guide?

This guide has information to help you decide whether to use NOLVADEX to lower your chance of getting breast cancer.

You and your doctor should talk about whether the possible benefit of NOLVADEX in lowering your high chance of getting breast cancer is greater than its possible risks. Your doctor has a special computer program or hand-held calculator to tell if you are in the high-risk group. If you have DCIS and have been treated with surgery and radiation therapy, your doctor

may prescribe NOLVADEX to decrease your chance of getting invasive (spreading) breast cancer.

Read this guide carefully before you start NOLVADEX. It is important to read the information you get each time you get more medicine. There may be something new. This guide does not tell you everything about NOLVADEX and does **not** take the place of talking with your doctor.

Only you and your doctor can determine if NOLVADEX is right for you.

What is the most important information I should know about using NOLVADEX to reduce the chance of getting breast cancer?

NOLVADEX is a prescription medicine that is like estrogen (female hormone) in some ways and different in other ways. In the breast, NOLVADEX can block estrogen's effects. Because it does this, NOLVADEX may block the growth of breast cancers that need estrogen to grow (cancers that are estrogen- or progesterone-receptor positive).

NOLVADEX can lower the chance of getting breast cancer in women with a higher than normal chance of getting breast cancer in the next five years (high-risk women) and women with DCIS. **Because high-risk women don't have cancer yet, it is important to think carefully about whether the possible benefit of NOLVADEX in lowering the chance of getting breast cancer is greater than its possible risks.**

This Medication Guide reviews the risks and benefits of using NOLVADEX to reduce the chance of getting breast cancer in high-risk women and women with DCIS. This guide does **not** discuss the special benefits and decisions for people who already have breast cancer.

Why do women and men use NOLVADEX?

NOLVADEX has more than one use. NOLVADEX is used:

to lower the chance of getting breast cancer in women with a higher than normal chance of getting breast cancer in the next 5 years (high-risk women)
to lower the chance of getting invasive (spreading) breast cancer in women who had surgery and radiation for ductal carcinoma in situ (DCIS). DCIS means the cancer is only inside the milk ducts.
to treat breast cancer in women after they have finished early treatment. Early treatment can include surgery, radiation, and chemotherapy. NOLVADEX may keep the cancer from spreading to others parts of the body. It may also reduce the woman's chance of getting a new breast cancer.
in women and men, **to treat** breast cancer that has spread to other parts of the body (metastatic breast cancer).

This guide talks only about using NOLVADEX to lower the chance of getting breast cancer (#1 and #2 above).

What are the benefits of NOLVADEX to lower the chance of getting breast cancer in high-risk women and in women treated for DCIS?

A large US study looked at **high-risk women** and compared the ones who took NOLVADEX for 5 years with others who took a pill without NOLVADEX (placebo). High-risk women were defined as women who have a 1.7% or greater chance of getting breast cancer in the next 5 years, based on a special computer program. In this study:

- Out of every 1,000 high-risk women **who took a placebo**, each year about 7 got breast cancer.
- Out of every 1,000 high-risk women **who took NOLVADEX**, each year about 4 got breast cancer.

The study showed that on average, high-risk women who took NOLVADEX lowered their chances of getting breast cancer by 44%, from 7 in 1,000 to 4 in 1,000.

Another US study looked at **women with DCIS** and compared those who took NOLVADEX for 5 years with others who took a placebo. In this study:

- Out of every 1,000 women with DCIS **who took placebo**, each year about 17 got breast cancer.
- Out of every 1,000 women with DCIS **who took NOLVADEX**, each year about 10 got breast cancer.

The study showed that on average, women with DCIS who took NOLVADEX lowered their chances of getting invasive (spreading) breast cancer by 43%, from 17 in 1,000 to 10 in 1,000.

These studies do not mean that taking NOLVADEX will lower your personal chance of getting breast cancer. We do not know what the benefits will be for any one woman who takes NOLVADEX to reduce her chance of getting breast cancer.

What are the risks of NOLVADEX?

In the studies described under "What are the benefits of NOLVADEX?", the high-risk women who took NOLVADEX got certain side effects at a higher rate than those who took a placebo. **Some of these side effects can cause death.**

In one study, in women who still had their uterus

- Out of every 1,000 women who took a placebo, each year 1 got endometrial cancer (cancer of the lining of the uterus) and none got uterine sarcoma (cancer of the body of the uterus).
- Out of every 1,000 women who took NOLVADEX, each year 2 got endometrial cancer and fewer than 1 got uterine sarcoma.

These results show that, on average, in high-risk women **who still had their uterus**, NOLVADEX doubled the chance of getting endometrial cancer from 1 in 1,000 to 2 in 1,000, and it increased the chance of getting uterine sarcoma. **This does not mean that taking NOLVADEX will double your personal chance of getting endometrial cancer or increase your chance of getting uterine sarcoma.** We do not know what this risk will be for any one woman. The risk is different for women who no longer have their uterus.

For all women in this study, taking NOLVADEX increased the risk of having a blood clot in their lungs or veins, or of having a stroke. In some cases, women died from these effects.

NOLVADEX increased the risk of getting cataracts (clouding of the lens of the eye) or needing cataract surgery. (See "What are the possible side effects of NOLVADEX?" for more details about side effects.)

What don't we know about taking NOLVADEX to reduce the chance of getting breast cancer?

We don't know

- if NOLVADEX lowers the chance of getting breast cancer in women who have abnormal breast cancer genes (BRCA1 and BRCA2)
- if taking NOLVADEX for 5 years reduces the number of breast cancers a woman will get in her lifetime or if it only delays some breast cancers
- if NOLVADEX helps a woman live longer
- the effects of taking NOLVADEX with hormone replacement therapy (HRT), birth control pills, or androgens (male hormones)
- the benefits of taking NOLVADEX if you are less than 35 years old

Studies are being done to learn more about the long-term benefits and risks of using NOLVADEX to reduce the chance of getting breast cancer.

What are the possible side effects of NOLVADEX?

The most common side effect of NOLVADEX is hot flashes. This is not a sign of a serious problem.

The next most common side effect is vaginal discharge. If the discharge is bloody, it could be a sign of a serious problem. [See "Changes in the lining (endometrium) or body of your uterus" below.]

Less common but serious side effects of NOLVADEX are listed below. These can occur at any time. Call your doctor right away if you have any signs of side effects listed below:

- **Changes in the lining (endometrium) or body of your uterus.** These changes may mean serious problems are starting, including cancer of the uterus. The signs of changes in the uterus are:

- Vaginal bleeding or bloody discharge that could be a rusty or brown color. You should call your doctor even if only a small amount of bleeding occurs.
- Change in your monthly bleeding, such as in the amount or timing of bleeding or increased clotting.
- Pain or pressure in your pelvis (below your belly button).

- **Blood clots in your veins or lungs.** These can cause serious problems, including death. You may get clots up to 2-3 months after you stop taking NOLVADEX. The signs of blood clots are:

  - sudden chest pain, shortness of breath, coughing up blood
  - pain, tenderness, or swelling in one or both of your legs

- **Stroke.** Stroke can cause serious medical problems, including death. The signs of stroke are:

  - sudden weakness, tingling, or numbness in your face, arm or leg, especially on one side of your body
  - sudden confusion, trouble speaking or understanding
  - sudden trouble seeing in one or both eyes
  - sudden trouble walking, dizziness, loss of balance or coordination
  - sudden severe headache with no known cause

- **Cataracts or increased chance of needing cataract surgery.** The sign of these problems is slow blurring of your vision.

- **Liver problems, including jaundice.** The signs of liver problems include lack of appetite and yellowing of your skin or whites of your eyes.

These are not all the possible side effects of NOLVADEX. For a complete list, ask your doctor or pharmacist.

Who should not take NOLVADEX?

Do not take NOLVADEX for any reason if you

- **Are pregnant or plan to become pregnant while taking NOLVADEX or during the 2 months after you stop taking NOLVADEX. NOLVADEX may harm your unborn baby.** It takes about 2 months to clear NOLVADEX from your body. To be sure you are not pregnant, you can start taking NOLVADEX while you are having your menstrual period. Or, you can take a pregnancy test to be sure you are not pregnant before you begin.
- **Are breast feeding.** We do not know if NOLVADEX can pass through your milk and harm your baby.

- **Have had an allergic reaction to NOLVADEX or tamoxifen** (the other name for NOLVADEX), or to any of its inactive ingredients.

If you get pregnant while taking NOLVADEX, stop taking it right away and contact your doctor. NOLVADEX may harm your unborn baby.

Do not take NOLVADEX to lower your chance of getting breast cancer if

- You ever had a blood clot that needed medical treatment.
- You are taking medicines to thin your blood, like warfarin, (also called Coumadin®*).
- Your ability to move around is limited for most of your waking hours.
- You are at risk for blood clots. Your doctor can tell you if you are at high risk for blood clots.
- You do not have a higher than normal chance of getting breast cancer. Your doctor can tell you if you are a high-risk woman.

How should I take NOLVADEX?

- Swallow the tablet(s) whole, with water or another non-alcoholic liquid. You can take NOLVADEX with or without food. Take your medicine every day. It may be easier to remember if you take it at the same time each day.
- If you forget a dose, take it when you remember, then take the next dose as usual. If it is almost time for your next dose or you remember at your next dose, do not take extra tablets to make up the missed dose.
- Take NOLVADEX for 5 years, unless your doctor tells you otherwise.
-

What should I avoid while taking NOLVADEX?

- **Do not become pregnant while taking NOLVADEX or for 2 months after you stop.** NOLVADEX can stop hormonal birth control methods from working. Hormonal methods include birth control pills, patches, injections, rings and implants. Therefore, while taking NOLVADEX, **use birth control methods that don't use hormones,** such as condoms, diaphragms with spermicide, or plain IUD's. If you get pregnant, stop taking NOLVADEX right away and call your doctor.
- **Do not breast feed.** We do not know if NOLVADEX can pass through your milk and if it can harm the baby.
-

What should I do while taking NOLVADEX?

- Have regular gynecology check-ups ("female exams"), breast exams and mammograms. Your doctor will tell you how often. These will check for signs of breast cancer and cancer of the endometrium (lining of the uterus). Because NOLVADEX does not prevent all breast cancers, and you may get other types of cancers, you need these exams to find any cancers as early as possible.
- Because NOLVADEX can cause serious side effects, pay close attention to your body. Signs you should look for are listed in "What are the possible side effects of NOLVADEX?"
- Tell all of the doctors that you see that you are taking NOLVADEX.
- Tell your doctor right away if you have any new breast lumps.

General information about the safe and effective use of NOLVADEX

Medicines are sometimes prescribed for purposes other than those listed in a Medication Guide. Your doctor has prescribed NOLVADEX only for you. Do not give it to other people, even if they have a similar condition, because it may harm them. Do not use it for a condition for which it was not prescribed.

This Medication Guide is a summary of information about NOLVADEX for women who use NOLVADEX to lower their high chance of getting breast cancer or who have DCIS. If you want more information about NOLVADEX, ask your doctor or pharmacist. They can give you information about NOLVADEX that is written for health professionals. For more information about NOLVADEX or breast cancer, please visit www.NOLVADEX.com or call 1-800-236-9933.

Ingredients: tamoxifen citrate, carboxymethylcellulose calcium, magnesium stearate, mannitol and starch.

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NATIONAL CANCER INSTITUTE

Cancer Facts

Date reviewed: 05/13/02

Chemoprevention

Chemoprevention is the use of natural or synthetic substances to reduce the risk of developing cancer, or to reduce the chance that cancer will recur (come back). The National Cancer Institute's (NCI) chemoprevention research effort started in the early 1980s and has grown considerably since that time. Currently, approximately 400 compounds are being studied as potential chemopreventive agents, mainly in laboratory research. Over 40 of these compounds are being studied in clinical trials (research studies with people). Some of these agents are being investigated as single agents; others are being tested in combinations of two drugs. Chemoprevention trials look at possible ways to prevent cancer with interventions that include drugs, vitamins, diet, hormone therapy, or other agents.

To identify possible chemopreventive agents, scientists analyze data obtained from studies of selected groups of people. For example, scientists might study a group with a lower-than-average rate of cancer to determine what factors could be protecting them from the disease. They might find that people who eat certain foods develop cancer less often than those who do not. The scientists might then isolate compounds from these foods and test their ability to prevent, halt, or reverse cancer development in cells grown in the laboratory. Compounds showing promise in these tests may be examined further in animals. When a substance shows promise in such studies, researchers may then evaluate it in clinical trials. For example, a clinical trial is being conducted to investigate the effectiveness of budesonide (an asthma drug) in preventing lung cancer. Scientists also test chemopreventive substances in people at high risk for cancer because of a precancerous condition, a family history of cancer, lifestyle factors such as smoking, or other factors. Other research involves people who have had cancer and have an increased chance of recurrence. More information is available on the NCI's Chemopreventive Agent Development Research Group's Web site at http://www3.cancer.gov/prevention/cadrg on the Internet.

Five classes of chemopreventive agents have shown promise in clinical trials and are considered priority substances for study. These agents include selective estrogen receptor modulators (SERMS) such as tamoxifen, and other hormonal agents; nonsteroidal anti-inflammatory drugs (NSAIDS); calcium compounds; glucocorticoids (compounds that are a type of steroid); and retinoids (chemical cousins of vitamin A).

Data reported in 1998 from the Breast Cancer Prevention Trial (BCPT)

showed that women taking tamoxifen had 49 percent fewer diagnosed cases of breast cancer. These results were the first clear indication that a chemopreventive agent could be effective in preventing cancer in a high-risk population. But because tamoxifen was associated with serious side effects, such as endometrial cancer and blood clots, researchers are comparing raloxifene (another SERM) with tamoxifen in the Study of Tamoxifen and Raloxifene (STAR) trial.

The NCI is currently sponsoring the Prostate Cancer Prevention Trial (PCPT) to see if the drug finasteride (used to treat patients with symptomatic noncancerous enlargement of the prostate, also called benign prostatic hyperplasia) can prevent prostate cancer in men who are age 55 or older. Finasteride reduces levels of dihydrotestosterone (DHT), a male hormone that is important in normal and abnormal prostate growth.

NSAIDS, such as aspirin, piroxicam, celecoxib, and sulindac, are being studied alone and in combination with other agents to see if they are useful preventive agents for people with a family history of colon polyps or cancer. In 1999, the Food and Drug Administration (FDA) approved the use of celecoxib to reduce the number of colorectal polyps in people with familial adenomatous polyposis (FAP), an inherited condition in which hundreds of polyps form in the colon and rectum. It is not yet known whether using celecoxib to reduce the number of polyps will also reduce the number of new cases or deaths from colorectal cancer. The NCI is also sponsoring chemoprevention trials studying the use of celecoxib for people at risk of cancers of the esophagus and bladder.

Calcium compounds are being studied for the prevention of colon cancer. These studies are being conducted mainly in people previously diagnosed with colon polyps or cancer.

Budesonide, a glucocorticoid used to treat asthma, is being studied in clinical trials to prevent the progression of precancerous changes in lung tissue. The drug is being given as a spray so that it reaches the lung tissue directly.

Scientists are also studying synthetic and natural retinoids alone and with other compounds for the prevention of several types of cancer, including cancers of the cervix, lung, oral cavity, and bladder. Other agents currently being investigated are selenium, vitamin E, 2-difluoromethylornithine (DFMO) (also called eflornithine), folic acid, oltipraz, and genistein.

NCI Priorities for Chemoprevention Research

In July 1998, NCI's Division of Cancer Prevention (DCP) convened the Chemoprevention Implementation Group (CIG) to further define and guide research in the field of chemopreventive agents. Members of the CIG included NCI staff and researchers outside the NCI, who represent a variety of disciplines related to chemoprevention. The CIG's task was to 1) set priorities for agents to be developed and evaluated in chemoprevention

clinical trials; 2) provide advice on the best designs for chemoprevention clinical studies; 3) identify research challenges and opportunities for chemoprevention; and 4) develop strategies for advancing chemoprevention research, such as attracting new scientists to the field. For a copy of the CIG's report, contact the Cancer Information Service (CIS) at 1–800–4–CANCER (1–800–422–6237) or visit the NCI's Publications Locator Web site at http://www.cancer.gov/publications on the Internet.

The DCP's Rapid Access to Preventive Intervention Development (RAPID) program was initiated as a result of recommendations made by the CIG. RAPID is designed to make NCI resources available to the research community for the preclinical and early clinical development of potential chemopreventive agents. The goal of RAPID is to facilitate the process of bringing discoveries from the laboratory to clinical trials.

Additional initiatives are planned for the development of animal models, the discovery of potential chemopreventive agents using technology from cancer genetics research, and the scientific validation of measures used to evaluate the effectiveness of chemopreventive agents.

The Future of Chemoprevention Research

Although scientists have some evidence that certain compounds may help prevent cancer in populations at higher risk, only large clinical trials conducted for many years with thousands of people can demonstrate whether a compound will reduce the risk of cancer in the general population. For more information about ongoing chemoprevention clinical trials, contact the CIS at the telephone number listed below or visit the clinical trials page of the NCI's Web site at http://www.cancer.gov/clinical_trials/ on the Internet.

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Sources of National Cancer Institute Information

Cancer Information Service

Toll-free: 1–800–4–CANCER (1–800–422–6237)
TTY (for deaf and hard of hearing callers): 1–800–332–8615

NCI Online

Internet

Use http://www.cancer.gov to reach NCI's Web site.

LiveHelp

Cancer Information Specialists offer online assistance through the *LiveHelp* link on the NCI's Web site.

Dictionary of Cancer Terms

Page Options

Print This Page

Quick Links

Director's Corner
Dictionary
Funding Opportunities
NCI Publications
NCI Calendar
Español

NCI Highlights

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NCI Web Site Named Best in Customer Satisfaction
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preventive

Used to prevent disease.

Previous: premalignant, premenopausal, prescription, pretracheal space, prevascular spa
Next: preventive mastectomy, primary care doctor, primary central nervous system ly primary endpoint, primary myelofibrosis

Chemoprevention of Breast Cancer

The U.S. Preventive Services Task Force (USPSTF) recommends against the routine use of the medications tamoxifen or raloxifene for the primary prevention of breast cancer in women at low or average risk for breast cancer. For women who are not at high risk for breast cancer, the potential harms of chemoprevention may outweigh the potential benefits.

The USPSTF recommends that clinicians discuss chemoprevention with women at high risk for breast cancer and at low risk for the adverse effects of chemoprevention, informing them of the potential benefits and harms. The balance of benefits and harms may be favorable for some women at high risk for breast cancer but depends on cancer risk, risk for adverse effects of chemoprevention, and individual patient preferences.

The USPSTF Recommendations and Rationale—as well as the Summary of Evidence, a press release, and a fact sheet are available below.

- Recommendations and Rationale
- Summary of the Evidence
- Systematic Evidence Review (File Download, 183 KB)
- Press Release
- What's New from the USPSTF (PDF File, 75 KB)

Return to U.S. Preventive Services Task Force
Clinical Information
AHRQ Home Page
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Prevention of breast cancer

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This information is intended mainly for use by doctors and other health care professionals. If you have questions about this topic, you can ask your doctor, or call the Cancer Information Service at 1-800-4-CANCER (1-800-422-6237).

Information from PDQ -- for Health Professionals

SUMMARY OF EVIDENCE

Note: Separate PDQ summaries on Screening for Breast Cancer; Breast Cancer Treatment; Male Breast Cancer Treatment; and Breast Cancer and Pregnancy are also available.

Tamoxifen

A randomized controlled trial has shown that tamoxifen reduces the risk of developing breast cancer in women at increased risk for the disease. Tamoxifen treatment also increases the risk of endometrial cancer and of thrombotic vascular events (pulmonary embolism, stroke, deep venous thrombosis). There are risks and benefits that have to be weighed, and decisions regarding use of tamoxifen for chemoprevention must be individualized.

Level of Evidence:

1aii: Evidence obtained from at least one well-designed and conducted randomized controlled trial that has an endpoint of breast cancer incidence

Hormone Replacement Therapy

Postmenopausal hormone replacement therapy (HRT) with estrogen alone or in combination with progesterone may be associated with increased risk of developing breast cancer. This risk may be proportionate to duration of use and worse for combination therapy.

Levels of Evidence:

3aii: Evidence obtained from well-designed and conducted cohort or case-control studies, preferably from more than one center or research group, that have a cancer incidence endpoint

4aii: Ecologic and descriptive studies (e.g., international patterns studies, migration studies, time series) that have a cancer incidence endpoint

Ionizing radiation

Exposure of the breast to ionizing radiation is associated with an increased risk of developing breast cancer, especially when the exposure occurs at a young age. This finding supports the avoidance of unnecessary breast irradiation.

Levels of Evidence:

3aii: Evidence obtained from well-designed and conducted cohort or case-control studies, preferably from more than one center or research group, that have a cancer incidence endpoint

4aii: Ecologic and descriptive studies (e.g., international patterns studies, migration studies, time series) that have a cancer incidence endpoint

Alcohol

Exposure to alcohol may also be associated with increased breast cancer risk.

Level of Evidence:

3aii: Evidence obtained from well-designed and conducted cohort or case-control studies, preferably from more than one center or research group, that have a cancer incidence endpoint

Exercise

Studies suggest that exercise at certain ages is associated with reduced breast cancer risk.

Level of Evidence:

3aii: Evidence obtained from well-designed and conducted cohort or case-control studies, preferably

from more than one center or research group, that have a cancer incidence endpoint

Prophylactic Bilateral Mastectomy

Bilateral prophylactic mastectomy is associated with a reduction in the risk of breast cancer by as much as 90% among women with an increased risk of breast cancer due to a strong family history of breast cancer. Because of the physical and psychological effects of bilateral mastectomy and the irreversibility of the procedure, decisions regarding this option must be carefully considered on an individual basis in association with risk assessment and counseling.

Levels of Evidence:

3ai,3aii: Evidence obtained from well-designed and conducted cohort or case-control studies, preferably from more than one center or research group, that have cancer mortality and cancer incidence endpoints

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SIGNIFICANCE

Incidence and Mortality

In the United States, a woman who lives to be 90 years old has a 1 in 8 risk of being diagnosed with breast cancer.[1] With 203,500 cases expected, breast cancer will be the most frequently diagnosed nonskin malignancy in U.S. women in 2002.[2] In the same year, breast cancer will kill approximately 39,600 women, second only to lung cancer as a cause of cancer mortality in women. Breast cancer also occurs in men, and there will be about 1,500 new cases in **2002.** Despite a prior long-term trend of gradually increasing breast cancer
incidence, data from the Surveillance, Epidemiology, and End Results (SEER) Program show that from 1989 to 1992 there was a 5% decrease in breast cancer mortality.

Early detection with effective treatment has reduced mortality in some groups of women with breast cancer. Nevertheless, especially in light of the large numbers of affected people, efforts to control this disease by developing primary prevention strategies continue.

Primary prevention of breast cancer involves a reduction in the incidence of invasive breast cancer, which should lead to a decrease in breast cancer mortality.

Etiology and Pathogenesis of Breast Cancer

Genetic, epidemiologic, and laboratory studies support a stochastic model of breast cancer development in which a series of genetic changes contribute to the dynamic process known as carcinogenesis.[3] An accumulation of genetic changes is thought to correspond to the phenotypic changes associated with the evolution of malignancy. The carcinogenesis sequence is viewed histologically as starting with tissue of normal appearance, followed by changes that lead to hyperplasia and dysplasia, of which the most severe forms are difficult to distinguish from carcinoma in situ.[4]

The concept that breast cancer may be preventable is supported by the wide international variation in breast cancer rates, which is an indicator that there are potentially modifiable environmental and lifestyle determinants of breast cancer. Migration studies reinforce this premise; e.g., it has been

observed that Japanese immigrants to the United States acquire much of the breast cancer risk of the host country within 2 generations.[5-7]

Endogenous Estrogen

Evidence for a role of ovarian hormones in the development of breast cancer is provided by studies of artificial menopause. Subsequent to ovarian ablation, breast cancer risk may be reduced up to 75%, depending on parity, weight, and age at the time of artificial menopause, with the greatest reduction for young, thin, nulliparous women.[8-11] It has been observed that removal of one ovary also reduces the risk of breast cancer, but to a lesser degree than the removal of both.[12]

Other events associated with hormonal changes have similarly been found to influence breast cancer risk. After a transient increase in risk after childbirth, there is a long-term reduction in risk.[11,13,14] The degree of risk reduction appears to be related to age. In 1 study, women who experienced a first full-term pregnancy before 20 years of age were one half as likely to develop breast cancer as nulliparous women or women who underwent a first full-term pregnancy at 35 years of age or older.[15] In addition to age at menopause and childbirth, age at menarche is a third factor that has been linked to breast cancer risk. Women who experienced menarche at 11 years of age or younger have about a 20% greater chance of developing breast cancer than women who experienced menarche at 14 years of age or older.[16] Reproductive risk factors may interact with more predisposing genotypes. In a report of the Nurses' Health Study,[17] the associations between age at first birth, menarche, and menopause and the development of breast cancer were observed only among women without a family history of breast cancer in a mother or sister. While modulation of reproductive risk factors or hormonal interventions that simulate the preventive effects of early pregnancy or early menopause are theoretically possible, these types of interventions may not be effective for all women, particularly those with a family history of breast cancer. Breast feeding is associated with a decreased risk of breast cancer.[18]

A number of studies suggest that endogenous estrogen levels are higher in women who develop breast cancer than in women who do not. Methods shown to decrease endogenous estrogen include adoption of a low-fat diet in postmenopausal women [19] and moderate exercise in adolescent girls.[20] Whether such interventions will decrease breast cancer risk is worthy of study.

Abortion

The results of studies of the relation between induced abortion history and breast cancer have been inconsistent,[21,22] which may reflect differences across populations in the extent of under-reporting of abortions due to social stigma, inadequate control for confounding variables, failure to examine induced abortions separately from spontaneous abortions, or other aspects of study design. One large population-based case-control study conducted among parous women in Shanghai, China, where induced abortion is common and not associated with social stigma, found no overall association between ever having had an induced abortion and breast cancer in analyses that controlled for multiple potential confounders (OR= 1.0, 95% CI, 0.8-1.2).[23] There was also no association of risk with having 3 or more induced abortions, age at first induced abortion, timing of first induced abortion relative to timing of first live birth, number of induced abortions relative to timing of first live birth, and interval between first induced abortion and diagnosis (for cases) or similar reference date (for controls). Owing to small numbers of women who had induced abortions prior to a first live birth or who had induced abortions at a very young age, the study could not examine the effect of these characteristics on breast cancer risk.

Genetic Mutations

The underlying susceptibility of an individual also influences the degree to which mutagens and growth factors accelerate the carcinogenic process. Known genetic syndromes, however, in which a high lifetime probability of developing breast cancer is attributed to a specific aberrant allele, contribute to the minority of breast cancers, estimated to be 5%. Work that identifies high-risk genes is important because of the insight into breast cancer etiology that will come from the study of these genes, and also the potential for identifying high-risk populations who are at increased need for a preventive intervention.

Among the growing list of such genes are BRCA1 (breast cancer 1) [24,25] and BRCA2 (breast cancer 2).[26] Women who inherit a deleterious mutation in BRCA1 or BRCA2 have an increased lifetime risk of breast and ovarian cancer and possibly colon cancer. Men are at increased risk of breast cancer (primarily BRCA2) and possibly prostate cancer. Deleterious mutations in BRCA2 have been associated with an increased risk of other cancers such as pancreatic cancer and lymphoma.[27] Estimates of the lifetime risk of breast cancer among women with BRCA1 or BRCA2 vary from 56% [28] to as high as 80% to 85%.[27] The variations in estimates of risk are due to differences in study populations and mutations evaluated.[29,30] One study was based on a volunteer population that likely self-selected for a family history, and it was suggested that even the 56% estimate may be an overestimate of risk associated with the studied mutations.[28] The upper estimate of risk comes from families with high incidence of breast and/or ovarian cancer and likewise may overestimate the risk for a more general population. Other genes and nongenetic factors may affect a deleterious-mutation carrier's cancer risk. A case report of identical twins who carry a deleterious BRCA1 mutation in which only 1 of the twins has developed breast and ovarian cancer emphasizes our lack of knowledge about other factors that influence when and if a deleterious-mutation carrier develops cancer.[31]

The percentage of inherited forms of breast cancer susceptibility in very high-risk families that may be attributed to deleterious mutations in BRCA1 was initially estimated to be 45% with a smaller proportion due to the less common BRCA2 mutations.[27] Breast cancers among women who carry an altered BRCA1 or BRCA2 gene tend to occur at younger ages than in other women.[27] Relatives of women with breast cancer may question their risks of having a genetic mutation which increases the risks of the disease. Since the lifetime risk of breast cancer in the general population is high (1 in 8),[1] the disease can be expected to affect more than one member of a family, especially a large family, even in the absence of a deleterious mutation in that family. A cancer genetics clinic-based study found a deleterious BRCA1 mutation in only 16% of women with a family history of breast cancer and/or ovarian cancer suspicious for an inherited susceptibility.[32] The probability of detecting a deleterious mutation is higher (40%) when there is a family history of both breast and ovarian cancer compared to women with a family history of breast cancer without ovarian cancer (7%).[32] Further, the ages of onset of breast cancers are important, with younger ages of onset being more likely associated with a deleterious mutation, especially a mutation in BRCA1.[33] Women who carry an abnormal AT (ataxia telangiectasia) gene may be at increased risk of breast cancer,[34] but it is not clear that these women are at increased risk of early-onset breast cancer (diagnosed at age 40 or younger).[34,35]

The prevalence of deleterious BRCA1 mutations is estimated to be 1/800 in the general population. Several mutations in BRCA1 and BRCA2 have been observed to occur with a higher frequency among individuals of Ashkenazi Jewish descent. These mutations include 185delAG and 5382insC for BRCA1 and 6174delT for BRCA2. A study of over 5,000 individuals of Ashkenazi Jewish descent observed a prevalence of 2.3% for these 3 mutations [28] which were associated with lifetime risks of 56% for breast cancer and 16% for ovarian cancer and prostate cancer. The goal is to use this genetic information to target women who may benefit from enhanced early detection or prevention strategies; however, at this time, there is little scientific evidence to support or quantify this potential beneficial effect.

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EVIDENCE OF BENEFIT

Ionizing Radiation Exposure

There is a well-established relationship between exposure to ionizing radiation and the risk of developing breast cancer.[1] Excess breast cancer risk is consistently observed in association with a variety of exposures such as fluoroscopy for tuberculosis and radiation treatments for acne, tinea, thymic enlargement, postpartum mastitis, or Hodgkin's disease. Although risk is inversely associated with age at radiation exposure, the manifestation of breast cancer risk occurs according to the usual age-related pattern. An estimate of the risk of breast cancer associated with medical radiology puts the figure at less than 1% of the total;[2] however, it has been theorized that certain populations, such as AT (ataxia telangiectasia) heterozygotes, are at increased risk from the usual sources of radiation exposure.[3] Cell-based assays and an in vivo mouse model suggest that loss of the BRCA2 protein increases the frequency of somatic mutations due to faulty repair of DNA double-strand breaks, which occur spontaneously and can be induced by ionizing radiation [4] at exposure levels similar to those experienced as part of mammography or whole-body computed tomography (CT) scans. If these findings hold true for humans, screening mammography and radiation treatment may increase cancer risk among individuals who have a deleterious BRCA2 mutation, and the risk-benefit analysis of these procedures will need to be reconsidered.

Women treated for Hodgkin's disease by age 16 may have a subsequent risk of developing breast cancer as high as 35% by age 40.[5] One study suggests that higher doses of radiation (median dose, 40 Gy in breast cancer cases) and treatment between 10 and 16 years of age correspond with higher risk.[5] An earlier study suggests a high level of breast cancer risk in women treated for Hodgkin's disease, especially those treated before age 15 with radiation to the thorax and/or neck.[6] When radiation therapy was administered after age 14, but before age 30, risk of developing breast cancer was also elevated, but to a lesser degree.[6] Unlike the risk for secondary leukemia, the risk of treatment-related breast cancer did not abate with duration of follow-up.[5,7] In these studies, the great majority (85%-100%) of patients who developed breast cancer did so either within the field of radiation or at the margin.[5-7] Whereas intensive mammographic screening has been advocated for this high-risk population, it is not known whether the additional radiation exposure could produce additional risk.

In theory, breast cancer patients treated with lumpectomy and radiation therapy (L-RT) may be at increased risk for second breast or other malignancies, compared to those treated by mastectomy. Outcomes of 1,029 L-RT patients treated at Yale, however, were compared to 1,387 patients who had mastectomy. After a median follow-up of 15 years, there was no difference in the risk of second malignancies.[8]

Environmental Factors

Evidence examining the effect of occupational, environmental, or chemical exposures on breast cancer risk is limited. Although some findings suggest that organochlorine exposures, such as those associated with insecticides, might be associated with an increase in breast cancer risk,[9,10] other case-control and nested case-control studies do not.[11-16] Across those studies that have observed positive associations, the specific organochlorines identified have not been consistently found. Thus, the possibility that such substances, some of which are known to have weak estrogenic effects, influence breast cancer risk remains unproven. The use of DDT was banned in the United States in 1972, and the production of PCBs (polychlorinated biphenyls) was stopped in 1977.

Dietary Factors

A low-fat diet might influence breast cancer risk through hormonal mechanisms. For example, it has been reported that dietary fat and postmenopausal estrogen levels are directly related.[17] The role of a low-fat diet in breast cancer prevention, however, remains to be defined. The evidence that such an approach might work is based in part on ecologic studies that show a positive correlation between international age-adjusted breast cancer mortality rates and the estimated per capita consumption of dietary fat.[18] When case-control studies have been used to evaluate the hypothesis that dietary fat is related to breast cancer risk, the results have been mixed. Individual analytic (case-control and cohort) epidemiologic studies in adults may be hampered by small numbers of cases, a relatively limited spectrum of fat intake, and dietary assessments that lack validation. A pooled analysis that incorporated results from 7 cohort studies has addressed these issues and concluded that there is no evidence for an association between total dietary fat intake and breast cancer risk. If this is true, lowering fat in the diet is unlikely to reduce breast cancer risk.[19] A prospective randomized study is the strongest study design to settle this issue.

The results of many case-control studies and several cohort studies suggest that fruit and vegetable consumption (or specific fruits or vegetables) may be associated with reduced breast cancer risk.[20] However, a pooled analysis of adult dietary data from 8 cohort studies, which included 351,823 women in whom 7377 incident cases of breast cancer occurred, provides little support for an association.[21] When examining the dietary data treated as continuous variables (based on grams of intake per day),

there was no association. Comparing highest to lowest quartiles of intake, the pooled multivariate relative risks of breast cancer were 0.93 (95% CI,0.86-1.00) for total fruits, 0.96 (95% CI, 0.89-1.04) for total vegetables, and 0.93 (95% CI, 0.86-1.00) for total fruit and vegetables combined. Likewise, there was no significant association between any of the specific fruits and vegetables examined and breast cancer risk. This analysis was subject to limitations common to attempts to combine dietary data across studies that have collected information using different food frequency questionnaires. However, it suggests that if there is any decreased risk of breast cancer associated with consumption of fruits and vegetables, the association is probably weak.

Lifestyle Factors

Other lifestyle factors known to alter hormonal milieu may affect breast cancer risk, e.g., exercise (anovulatory cycles),[22] postmenopausal weight gain,[23] and smoking (aromatase inhibition).[24] Although active exercise may reduce breast cancer risk particularly in young parous women,[25] there is little evidence to suggest a net effect of smoking on breast cancer risk.[26] There are numerous observational studies that have examined the relationship between physical activity and breast cancer risk.[27] Most of these studies have shown an inverse relationship between level of physical activity and breast cancer incidence. The average relative risk reduction is reportedly 30-40%. However, it is not known if or to what degree the observed association is due to confounding variables, such as diet or a genetic predisposition to breast cancer. A prospective study of over 25,000 women in Norway suggests that doing heavy manual labor or exercising 4 or more hours per week is associated with a decrease in breast cancer risk. This decrease is more pronounced in premenopausal women and in women of normal or less than normal body weight.[28] In a case-control study of African American women, strenuous recreational physical activity (greater than 7 hours per week), was associated with decreased breast cancer incidence.[29] Case-control studies suggested that alcohol consumption is associated with a modestly increased risk of breast cancer.[30,31] Several [32] but not all [33-35] prospective studies demonstrated such an effect.[32,36,37] In a cohort study of 89,538 U.S. nurses, 601 cases of breast cancer were diagnosed after 4 years.[36] Among those women consuming about 3 to 9 drinks per week (5-14 g/day), the relative risk (RR) of breast cancer was 1.3 (95% CI 1.1-1.7) compared with nondrinkers. A higher level of alcohol consumption was associated with a somewhat higher RR, 1.6 (95% CI 1.3-2.0). Studies, however, have been inconsistent with respect to the effect of dose, duration, age and currency of exposure, menopausal status, and other factors. This inconsistency is possibly related to the difficulty of collecting accurate information about alcohol use. In addition, a biological mechanism for the association has not been established. Until further study results are available, there will be uncertainty about the existence of modifiable breast cancer risks related to alcohol, exercise, and low-fat diet.

Micronutrient intake may also play a role. Case control studies show an inverse association between dietary beta-carotene intake and breast cancer risk.[38,39] High intake of foods containing folate,[40] beta-carotene, and vitamins A and C [38] may also reverse the increased risk associated with alcohol use.

In the Women's Health Study, in which 39,876 women were assigned to take beta-carotene or placebo, cancer incidence was unaffected at 2 years.[41]

Exogenous Estrogen (OC and HRT)

Of the many proliferative factors that may contribute to breast carcinogenesis, by far the most discussed and studied is estrogen, whether endogenous or exogenous.[42,43] Estrogen stimulates the growth of breast tumor cells with an increase in the levels of growth stimulatory factors like transforming growth

factor (TGF)-alpha. As a so-called antiestrogen, tamoxifen increases breast cell growth inhibitory factors like TGF-beta [44] and concomitantly reduces stimulatory factors (TGF-alpha and inhibitory growth factor-1).[45]

Many studies have shown that oral contraceptive (OC) use is associated with an increase in a young woman's risk of breast cancer, although some studies suggest that the risk may be limited to recent use. A case-control study comparing no use of OC to having used OC for 12 years or longer was associated with a modest but not statistically significant elevated risk of breast cancer with an odds ratio of 1.4 (95% confidence interval (CI) 0.8-2.4).[46]

There are data to suggest that hormone replacement therapy (HRT) with estrogen is associated with increased risk of developing breast cancer, primarily in recent users,[47,48] which is proportionate to duration of HRT use.[49] The excess breast cancers occurring after 5, 10, and 15 years are estimated to be 2, 6, and 12 per 1,000 women. It does not appear that there is a substantial difference in the relative risk associated with HRT in women with a family history of breast cancer compared to women with no family history.[50,51] Based on 2 large case-control studies, it appears that the risk of breast cancer is greater in users of combined estrogen and progestin HRT than in users of estrogen replacement therapy (ERT) alone.[48,52] In 1 of the studies, the multivariate adjusted odds ratio (OR) for combined HRT for every 5 years of use was 1.24 (95% CI 1.07-1.45) relative to nonuse.[52] Risk estimates were higher for sequential estrogen plus progestin replacement therapy (OR=1.38; 95% CI 1.13-1.68) than for continuous combined replacement therapy (OR=1.09; 95% CI 0.88-1.35), but this difference was not statistically significant. In that study, ERT was associated with a statistically significant increased risk of breast cancer only in users of 15 or more years, and when data were analyzed by stage of disease, ERT was associated with an increased risk of in situ but not invasive breast cancer. Patients considering the use of HRT should weigh its potential adverse effect on breast cancer risk against the evidence from observational studies that it may reduce overall mortality.[47,51] Breast cancers diagnosed in women on HRT may have more favorable size and growth characteristics, which may reflect a difference in biologic behavior or increased surveillance among these women.[53,54]

In longitudinal studies, greater age-specific mammographic density is associated with an increased risk for breast cancer. In a randomized, placebo-controlled study to assess the long-term effects of conjugated equine estrogens (CEE) alone and CEE with 3 progestin regimens on mammographic parenchymal density in postmenopausal women, 8% of estrogen users and 19% to 24% of estrogen-progestin users had an increase in mammographic density.[55] This increase in parenchymal density did not show any statistically significant difference by progestin regimen. In a double-blind, randomized, placebo-controlled osteoporosis prevention trial, women receiving ERT had statistically significantly higher breast density after 2 years of treatment than women receiving raloxifene or placebo. Within treatment groups, breast density tended to increase for those receiving ERT, and decreased significantly for other study groups.[56] Further study is needed to determine if increasing mammographic density might serve as a marker for women whose risk for breast cancer is increased by HRT.

Selective Estrogen Receptor Modulators (SERMs)

Data from adjuvant breast cancer trials using tamoxifen have shown that tamoxifen not only suppresses the recurrence of breast cancer but also prevents the occurrence of second primary breast cancers in the contralateral breast.[57] Tamoxifen may also have additional favorable effects by maintaining bone density among postmenopausal women with breast cancer and by lowering deaths from coronary heart disease.[58-62] Adverse effects include an increased risk of endometrial cancer.[63,64] Also, there is a possible risk of bone loss among premenopausal women.[59]

Observations from adjuvant breast cancer trials were the basis for a large chemoprevention trial (13,388 subjects at elevated risk of breast cancer) for the evaluation of the usefulness of tamoxifen for breast cancer prevention.[65] A preliminary report of the results from this double-blind trial comparing tamoxifen versus placebo became available in April 1998 (refer to the Cancer.gov Web site at: Http: //www.cancer.gov/). The independent Monitoring Committee for the Breast Cancer Prevention Trial (BCPT) concluded that the strength of the results justified an early conclusion to the trial with announcement of the results. The main finding was a 49% reduction in the incidence of breast cancer among the participants who were randomly assigned to receive tamoxifen. Among the 13,388 participants, after a mean follow-up of about 4 years, 154 cases of invasive breast cancer had developed in the women taking placebo compared with 85 cases of invasive breast cancer in the women taking tamoxifen. A similar reduction in noninvasive breast cancers was observed with 59 cases in the placebo group compared with 31 cases in women taking tamoxifen. Another benefit of tamoxifen use was a reduction in fractures, with 47 occurring in the tamoxifen-treated women compared with 71 in the placebo group. These benefits were accompanied by an increased incidence in women aged 50 and above of endometrial cancer and thrombotic events. There were 33 endometrial cancers and 99 vascular events (including 17 cases of pulmonary embolism and 30 cases of deep vein thrombosis) in women taking tamoxifen compared with 14 endometrial cancers and 70 vascular events (including 6 cases of pulmonary embolism and 19 cases of deep vein thrombosis) in women taking placebo.[66] Decisions are complex and need to be individualized, weighing estimates of a woman's chance of reducing breast cancer and fracture risks against the chance of developing detrimental side effects, some of which may be life threatening. The risks and benefits of taking tamoxifen have been estimated for women according to age, race, and risk group based on the results of the Breast Cancer Prevention Trial, additional risk/benefit analyses, and review of the literature.[67] Because adverse effects of tamoxifen increase with age, tamoxifen is most beneficial for women under the age of 50 with an increased risk of developing breast cancer. Overall, the net benefit or risk depends on age, whether or not a woman has a uterus, and her baseline risk of breast cancer.

There are other ongoing randomized trials in Europe testing the efficacy of tamoxifen for the primary prevention of breast cancer. Interim analyses from 2 smaller trials, 1 in the United Kingdom [68] and 1 primarily in Italy,[69] showed no protective effect perhaps because of differences in their target populations and study designs compared to the U.S. study. The U.K. study focused on 2,471 women at increased breast cancer risk because of their family history of breast and/or ovarian cancer; about 36% of participants were from families that had a greater than 80% chance of carrying a breast cancer susceptibility gene. After a median follow-up of nearly 6 years, no protective effect of tamoxifen was detected (RR=1.06). The Italian study focused on 5,408 women who had undergone hysterectomy, who were described as "low-to-normal risk" women; about 18% of women had a family history of breast cancer among first-degree relatives or aunts. After a median follow-up of nearly 4 years, they observed no protective effect of tamoxifen. Subgroup analyses suggested a protective effect among women who were taking HRT during the trial. Results could be helpful in establishing a risk-benefit profile that is applicable to women of various ages and risk categories.

These 3 trials were not designed, however, to detect differences in mortality.

Women with a history of ductal carcinoma in situ (DCIS) are at increased risk (3.4%) for a subsequent contralateral breast cancer similar to or greater than the risk for women with atypical hyperplasia or lobular carcinoma in situ (LCIS).[70] Five-year rates of all breast cancer (ipsilateral and contralateral) for women with DCIS treated with lumpectomy and radiation are 13.4%; a rate markedly higher than women with LCIS or atypical hyperplasia.[70] While women with atypical hyperplasia or LCIS were eligible for the Breast Cancer Prevention Trial, women with DCIS were not because of competing treatment trials. Thus, a question may arise as to whether or not women with DCIS should consider tamoxifen in order to lower their risk of subsequent breast cancer. The NSABP B-24 randomized

controlled trial evaluated the added benefit of tamoxifen to lumpectomy and radiation therapy for women with DCIS.[70] The risk of all breast cancer events, invasive and noninvasive, was reduced with tamoxifen (rate ratio 0.63; 95% CI 0.47-0.83); the risk of contralateral breast cancer (invasive and noninvasive) associated with tamoxifen was 0.49 (95% CI 0.26-0.87). Given the results of the NSABP B-24 trial and the Breast Cancer Prevention Trial, it is reasonable to consider the use of tamoxifen for breast cancer risk reduction among women with DCIS.

In addition to tamoxifen, other hormonal manipulations have been proposed that may modulate the production of breast cell growth factors by suppressing ovarian function [71] or changing the endogenous hormonal environment.[72] The list of chemoprevention agents that may be used in breast cancer prevention is long.

Raloxifene hydrochloride is a SERM that has antiestrogenic effects on breast and endometrial tissue and estrogenic effects on bone, lipid metabolism, and blood clotting.[73] The Multiple Outcomes of Raloxifene Evaluation (MORE), a randomized, double-blind trial evaluated 7,705 postmenopausal women with osteoporosis from 1994-1998 at 180 clinical centers in the United States. The effect on breast cancer incidence was a secondary endpoint, and therefore should be judged with caution. Raloxifene is still investigational for this use. After a median follow-up of 47 months, the risk of invasive breast cancer decreased by 72%.[74] Breast cancer was reported in 79 women and confirmed in **77.** Invasive breast cancer occurred in 39 women on placebo and 22 women randomized to either of the 2 raloxifene arms (raloxifene 120 mg daily; or raloxifene 60 mg; or placebo) (RR=0.248; 95% CI 0.17-0.446) (4.7 and 1.3 invasive breast cancers per 1000 woman-years in the placebo and combined treatment groups, respectively). DCIS occurred in 5 women on the placebo and 11 women on raloxifene. Combining noninvasive and invasive cancer occurrences the relative risk of breast cancer among women on raloxifene was 0.38 (95% CI 0.24-0.58) (5.3 and 1.9 breast cancers per 1000 woman-years in the placebo and combined treatment groups, respectively). As with tamoxifen, raloxifene appeared to reduce the risk of estrogen receptor-positive breast cancer but not estrogen receptor-negative breast cancer. Similar to tamoxifen, raloxifene is associated with an excess risk of hot flashes and thromboembolic events. The risk of venous thromboembolic disease (deep venous thrombosis or pulmonary embolism) was 2.4 times higher in women assigned to the raloxifene groups than to the placebo group. One woman (in the 60 mg raloxifene group) died due to pulmonary embolism. There was little difference in the rate of venous thromboembolic disease between the 60 and 120 mg groups (3.32 and 3.63 events per 1000 woman-years, respectively). No excess risk of endometrial cancer was observed by 47 months of follow-up; 5 cases occurred among women on placebo (0.77 cases per 1000 woman-years) and 5 among women treated with 60mg raloxifene (0.77 cases per 1000 woman-years) and 4 cases among women treated with 120mg of raloxifene (0.60 cases per 1000 woman years). Raloxifene did not increase the risk of endometrial hyperplasia.[75] Of 1,781 women who underwent transvaginal ultrasonography at baseline and had at least 1 follow-up test, endometrial thickness increased by an average of 0.01 mm in the raloxifene groups and decreased by 0.27 mm in the placebo group after 3 years of follow-up ($p<.01$ for the difference between the 2 groups). Sixty participants (10.1%) in the placebo group and 168 women (14.2%) in the raloxifene groups ($p=.02$) had endometrial thickness that was more than 5 mm on at least 1 follow-up ultrasound. Among the 196 women who still had a uterus (48 in the placebo group and 148 in the raloxifene group) there were 3 cases of hyperplasia and 2 cases of endometrial cancer in the placebo group and 3 cases of hyperplasia and 2 cases of endometrial cancer in the combined raloxifene group. Subgroup analyses after 4 years of follow-up suggest that, among women who have osteoporosis, raloxifene reduces breast cancer incidence for both women at higher and women at lower risk of developing breast cancer. It is not known if women without osteoporosis would benefit in the same way.[76] Raloxifene is being compared directly to tamoxifen in the randomized trial, called the Study of Tamoxifen and Raloxifene (STAR) to be conducted in 22,000 women by the National Surgical Adjuvant Breast and Bowel Project (NSABP).[77]

Vitamin Analogues

Another agent that has undergone investigation is fenretinide,[78] a vitamin A analogue which has been shown to reduce breast carcinogenesis in preclinical studies. A phase III trial to assess the efficacy of a 5-year intervention with fenretinide versus no treatment was conducted in 2,972 women, aged 30 to 70 years, with surgically removed stage I breast cancer or DCIS. Women recruited from 10 Italian institutions were randomly assigned to receive fenretinide (200 mg/day) for 5 years or no treatment. The primary endpoint was the incidence of contralateral or ipsilateral breast cancer 7 years after randomization. At a median observation time of 97 months, there were no statistically significant differences in the occurrence of contralateral breast cancer (p=0.642) or ipsilateral breast cancer (p=0.177) between the 2 arms. A potential interaction was detected, however, between fenretinide treatment and menopausal status in both outcomes (p=0.045), with a possible beneficial effect in premenopausal women (contralateral breast cancer: adjusted hazard ratio (HR)=0.66, 95% CI 0.41-1.07; ipsilateral breast cancer: adjusted HR=0.65, 95% CI 0.46-0.92) and an opposite effect in postmenopausal women (contralateral breast cancer: adjusted HR=1.32, 95% CI 0.82-2.15; ipsilateral breast cancer:

adjusted HR=1.19, 95% CI 0.75-1.89). There were no statistically significant differences between the 2 arms in tumors in other organs, incidence of distant metastases, and all-cause mortality.[79] The evidence supporting these approaches, however, is much less developed than that for tamoxifen intervention, and these approaches may be characterized as investigational.

Prophylactic Mastectomy

A retrospective cohort study was conducted to evaluate the impact of bilateral prophylactic mastectomy on the subsequent occurrence of breast cancer among women at high and moderate risk of breast cancer on the basis of family history.[80] The majority of women in this retrospective series (90%) had undergone subcutaneous rather than total mastectomy, which is the procedure of choice for maximum breast tissue removal. Median follow-up after surgery was 14 years. All women included in the report had some family history of cancer and were classified as high risk or moderate risk for breast cancer based on the pattern of breast cancer in the family. Expected cases of breast cancer were estimated using the Gail model for moderate-risk women and for high-risk women, the observed rates of breast cancer among sisters of the probands. The reduction in risk for moderate-risk women was 89% and for high-risk women the reduction ranged from 90% to 94% depending on the method used to calculate expected rates of breast cancer. The reduction in risk of death from breast cancer ranged from 100% among moderate-risk women to 81% among high-risk women. Information of BRCA1 or BRCA2 mutation status was not known. Although this study provides the best evidence available to date that prophylactic surgery offers benefits despite the fact that some breast tissue remains following surgery, some factors may bias the estimate of benefit. For example, criteria used to classify women at high risk would include women from families misclassified as an autosomal dominant inherited pattern and women from inherited syndrome families who are not at high risk because they did not inherit the susceptibility genotype. These factors may tend to overestimate the benefits of prophylactic surgery. It is important to note that most of the women who underwent prophylactic surgery would never have gone on to develop breast cancer. Thus, many were treated for the few who truly benefitted by having their breast cancer prevented. Among the 425 moderate-risk women who had prophylactic mastectomy the estimated number of breast cancer cases expected to occur was 37.4; among the 214 high-risk women the estimates ranged from 30.0 to 52.9, depending on the model used to estimate breast cancer occurrence. Thus, consideration of bilateral prophylactic mastectomy as an option for women should be done in association with cancer risk assessment and counseling regarding all the available preventive options, which now include tamoxifen as a preventive agent.[66]

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NATIONAL CANCER INSTITUTE

Cancer Facts

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Breast Cancer Prevention Studies

Breast cancer prevention studies are clinical trials that explore ways of reducing the risk, or chance, of developing breast cancer. Prevention studies are usually conducted with healthy women who have not had breast cancer, but have a high risk for this disease. Through such studies, scientists hope to determine what steps are effective in reducing the risk of breast cancer in women of all races and ethnic backgrounds.

Most breast cancer prevention research is based on evidence that the development of this disease is linked to exposure to the hormone estrogen. Many breast cancer prevention studies are testing the effectiveness of drugs called selective estrogen receptor modulators (SERMs). SERMs are drugs that have some estrogen-like properties and some anti-estrogen properties. For example, their estrogen-like properties may help prevent the loss of bone density in postmenopausal women, and may cause some premenopausal women to become more fertile. Their anti-estrogen activity may help reduce the risk of breast cancer by blocking the effects of estrogen on breast tissue.

The Breast Cancer Prevention Trial (BCPT)

The Breast Cancer Prevention Trial (BCPT) was a clinical trial funded by the National Cancer Institute (NCI) and conducted by the National Surgical Adjuvant Breast and Bowel Project (NSABP). The BCPT was designed to see whether tamoxifen, a SERM, can prevent breast cancer in women who are at an increased risk of developing this disease. The study began recruiting participants in April 1992 and closed enrollment in September 1997. This study involved 13,388 premenopausal and postmenopausal women at more than 300 centers across the United States and Canada and is one of the largest breast cancer prevention studies to date.

Results of the BCPT, reported in the September 16, 1998, *Journal of the National Cancer Institute*, showed 49 percent fewer diagnoses of invasive breast cancer in women who were randomized to take tamoxifen compared with women who were randomized to take a placebo (an inactive substance that looks the same as, and is administered in the same way as, a drug in a clinical trial). Women on tamoxifen also had 50 percent fewer diagnoses of noninvasive breast tumors, such as ductal or lobular carcinoma in situ. Nine women died of breast cancer, three women in the tamoxifen group and six women in the placebo group.

In the BCPT, most of the side effects associated with tamoxifen were temporary. However, there were some long-term risks, including several serious health problems: endometrial cancer (cancer of the lining of the uterus), uterine sarcoma (cancer of the muscular wall of the uterus), pulmonary embolism (blood clot in the lung), deep vein thrombosis (blood clot in a large vein), and stroke. Because of these risks, women taking tamoxifen should be monitored by their doctors for any sign of serious side effects. All BCPT participants have been asked to undergo regular followup examinations.

BCPT participants who were randomized to the tamoxifen group and had not completed 5 years of tamoxifen therapy when the study ended were given the opportunity to continue on therapy. Postmenopausal women who had been taking the placebo were invited to participate in another trial, the Study of Tamoxifen and Raloxifene (STAR). (See the following section for a description of this trial.) Women in the BCPT placebo group also have the option of seeking tamoxifen from their doctor.

The Study of Tamoxifen and Raloxifene (STAR)

The NSABP is conducting the Study of Tamoxifen and Raloxifene, known as STAR, which is seeking about 22,000 participants. STAR will involve postmenopausal women who are at least 35 years old and are at increased risk for developing breast cancer. The study will determine whether raloxifene, another SERM, is also effective in reducing the risk of developing breast cancer in women who have not had the disease, and whether the drug has benefits over tamoxifen, such as fewer side effects. As with tamoxifen, most of the known side effects of raloxifene are temporary, but women taking raloxifene are at increased risk for pulmonary embolism and deep vein thrombosis. For people in the United States, information on STAR is available from the NCI's Cancer Information Service (CIS) at 1–800–4–CANCER (1–800–422–6237); people in Canada may call the Canadian Cancer Society's Cancer Information Service toll-free at 1–888–939–3333. Information about this study is also available at http://www.cancer.gov/star on the Internet.

Capital Area SERM Study

The NCI is conducting the Capital Area SERM Study to evaluate the safety of raloxifene in premenopausal women between the ages of 23 and 47 who are at increased risk for breast cancer. This study is in progress at the National Institutes of Health's Warren Grant Magnuson Clinical Center and the National Naval Medical Center, both in Bethesda, Maryland. Women who are interested in participating in this study or who would like to have additional information may call the NCI Clinical Studies Support Center at 1–888–624–1937.

Other Breast Cancer Prevention Studies

Studies are being conducted with other drugs to determine if they may help

to reduce the risk of breast cancer. Also, researchers are looking at the effect of a low-fat diet on breast cancer risk. More information on these studies is available from the CIS at 1–800–4–CANCER (1–800–422–6237).

A paper published in the January 14, 1999, issue of *The New England Journal of Medicine* described a study of women who had undergone surgery to remove their breasts (double mastectomy) because they were at high risk of breast cancer due to a family history of this disease. In this study, prophylactic (preventive) mastectomy was associated with a significant reduction in the number of cases of breast cancer.

Another study of prophylactic mastectomy in women with an increased risk of breast cancer was published in the November 7, 2001, issue of the *Journal of the National Cancer Institute.* The participants included women with a high risk of breast cancer due to alterations in their BRCA1 or BRCA2 genes. (Certain alterations in these genes are known to increase a person's risk of breast cancer and several other types of cancer.) The researchers found that prophylactic mastectomy was associated with a substantial reduction in the number of cases of breast cancer not only in women with a family history of the disease, but also in women with BRCA1 or BRCA2 alterations.

NCI Priorities for Breast Cancer Prevention Research

Recognizing the impact of breast cancer on our society, in 1997 the NCI convened a Breast Cancer Progress Review Group of experts and advocates to analyze the NCI's breast cancer research activities and develop recommendations for the future. Based on its assessment of the status of breast cancer research, the review group recommended research priorities to accelerate progress in breast cancer prevention and treatment. In August 1998, the group published its report, *Charting the Course: Priorities for Breast Cancer Research.* This report is available at http://prg.nci.nih.gov/breast/finalreport.html on the Internet.

The review group identified key areas that need to be addressed. New strategies are needed to help researchers take discoveries from the laboratory and effectively study them with people. One of the recommendations in the report is that the NCI devote more funding to prevention research and increase the number of high-quality prevention studies. It is also important to encourage participation in studies, and seek suggestions about the types of studies in which women would be willing to participate. In addition, the review group recommended that researchers focus on increasing minority participation in prevention studies.

Estimating Breast Cancer Risk

No one knows why some women develop breast cancer and others do not. However, it is clear that breast cancer occurs more often in older women, and researchers have identified other risk factors that increase a woman's chance of getting the disease. Still, most women who develop breast cancer

have no known risk factors (other than growing older), and most women who have known risk factors do not get breast cancer.

Scientists at the NCI and the NSABP have developed a computer program called the Breast Cancer Risk Assessment Tool. This tool can help women and their health care providers estimate a woman's chances of developing breast cancer based on several recognized risk factors. The Breast Cancer Risk Assessment Tool also provides information on tamoxifen. A copy of the computer program may be ordered by calling the NCI's Cancer Information Service (CIS) at 1–800–4–CANCER (1–800–422–6237), or from the NCI Publications Locator at http://www.cancer.gov/publications on the Internet.

Doctors generally suggest that high-risk women be closely monitored and have regular medical checkups so that, if breast cancer develops, it is likely to be detected at an early stage. These women may also consider participating in prevention studies, taking tamoxifen, or undergoing preventive mastectomy. The decision is an individual one. With any medical procedure or intervention, both the benefits and the risks of the therapy must be considered. The balance of these factors will vary depending on a woman's personal and family health history and how she weighs the benefits and risks. Women who are considering taking steps to reduce the risk of breast cancer should discuss their personal risk factors with their doctor.

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Sources of National Cancer Institute Information

Cancer Information Service

Toll-free: 1–800–4–CANCER (1–800–422–6237)
TTY (for deaf and hard of hearing callers): 1–800–332–8615

NCI Online

Internet
Use http://www.cancer.gov to reach NCI's Web site.

LiveHelp
Cancer Information Specialists offer online assistance through the *LiveHelp* link on the NCI's Web site.